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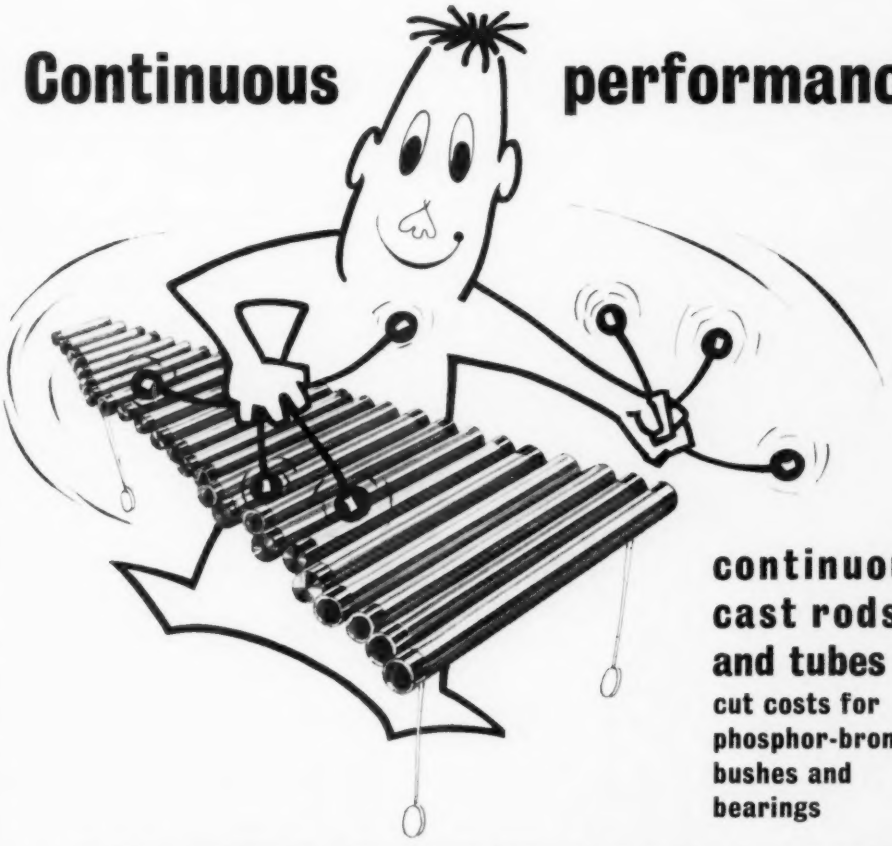

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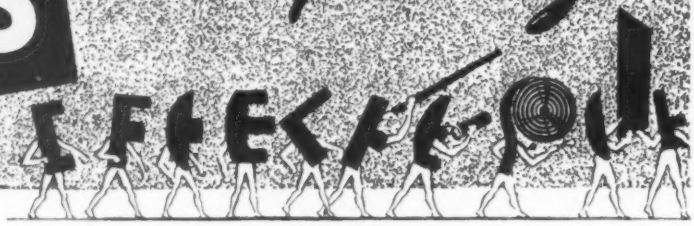

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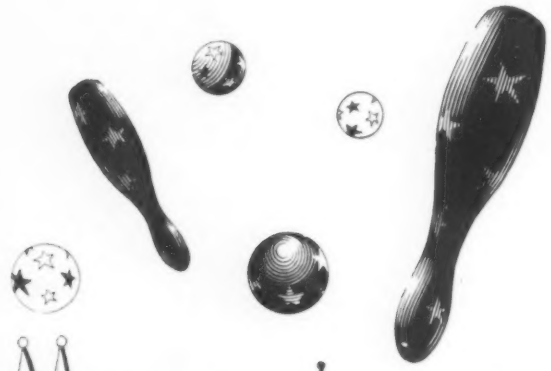

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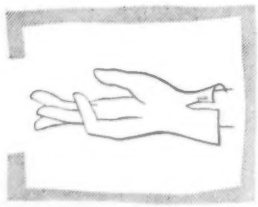

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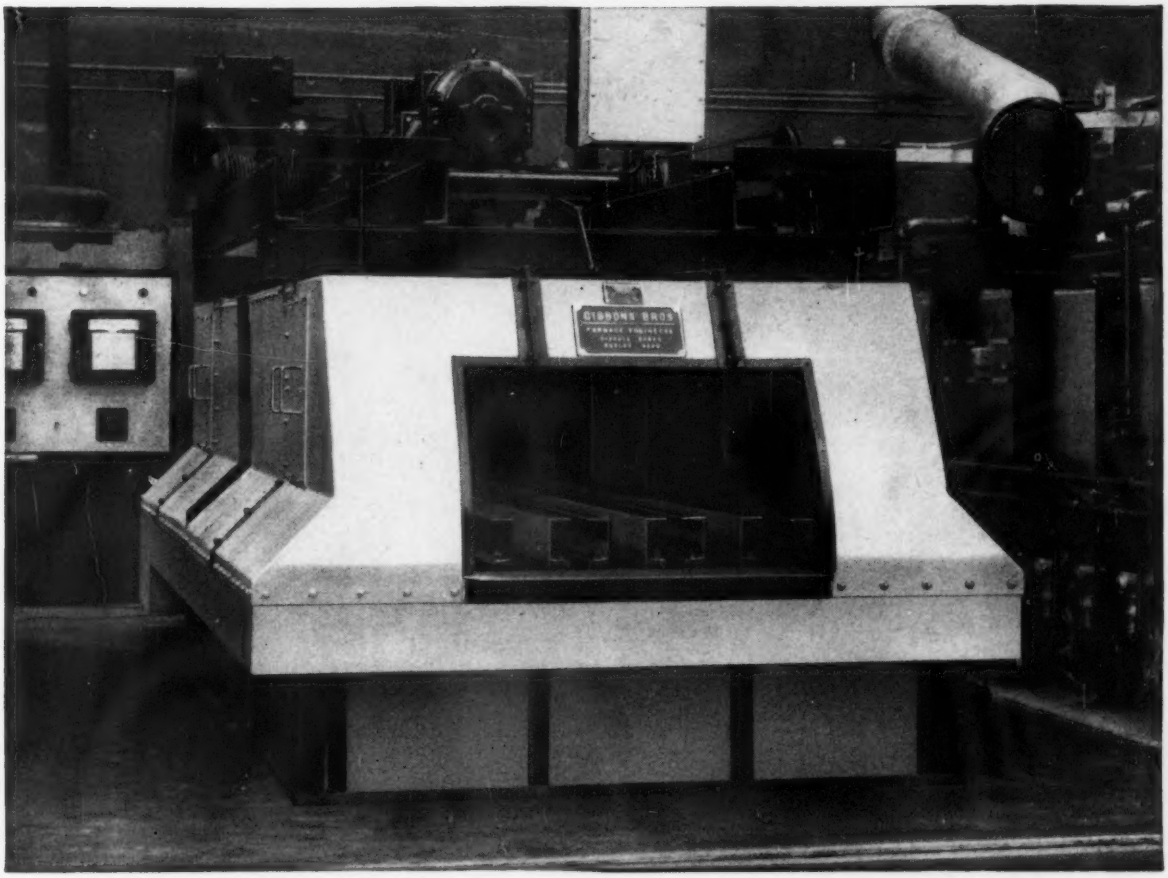

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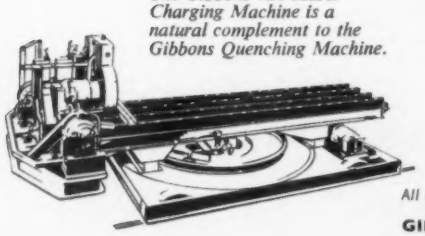

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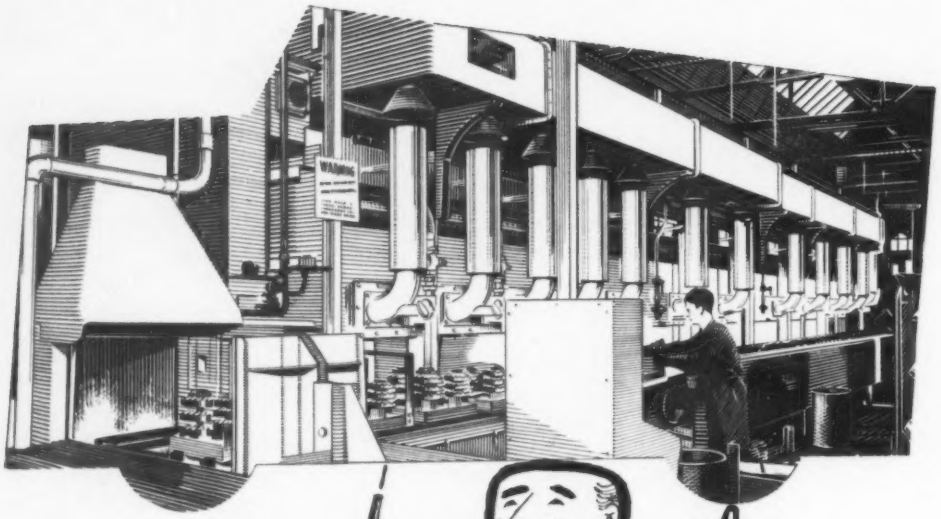

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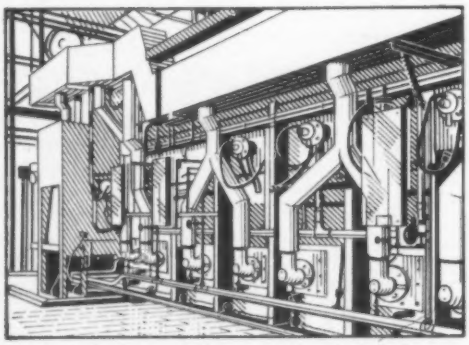

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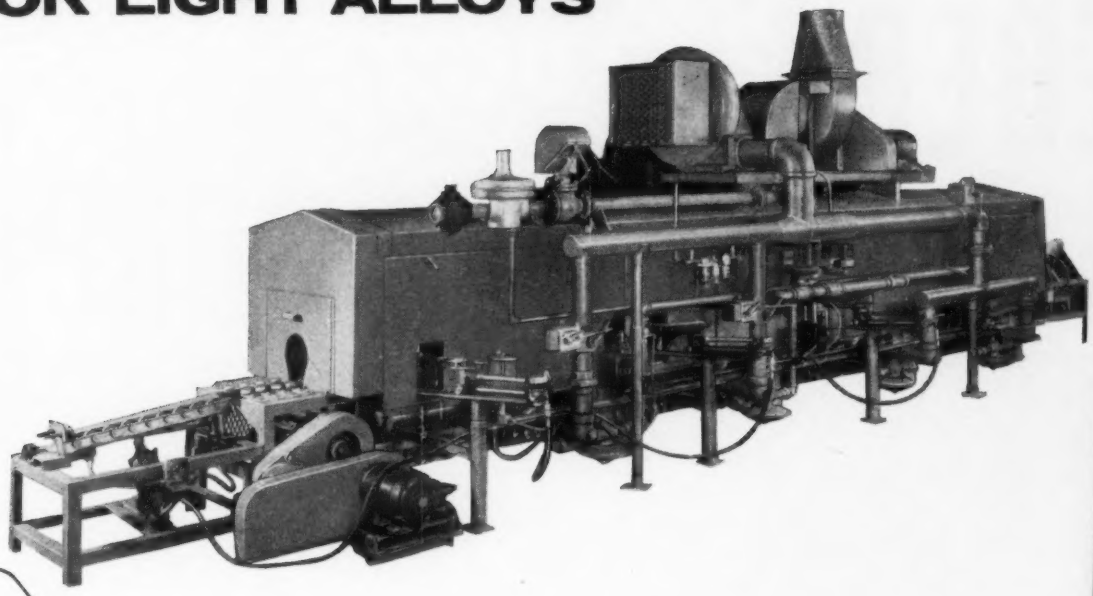

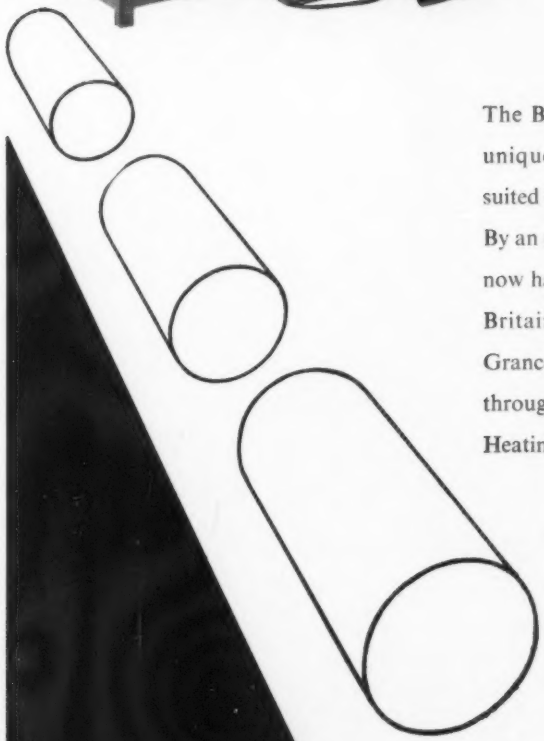

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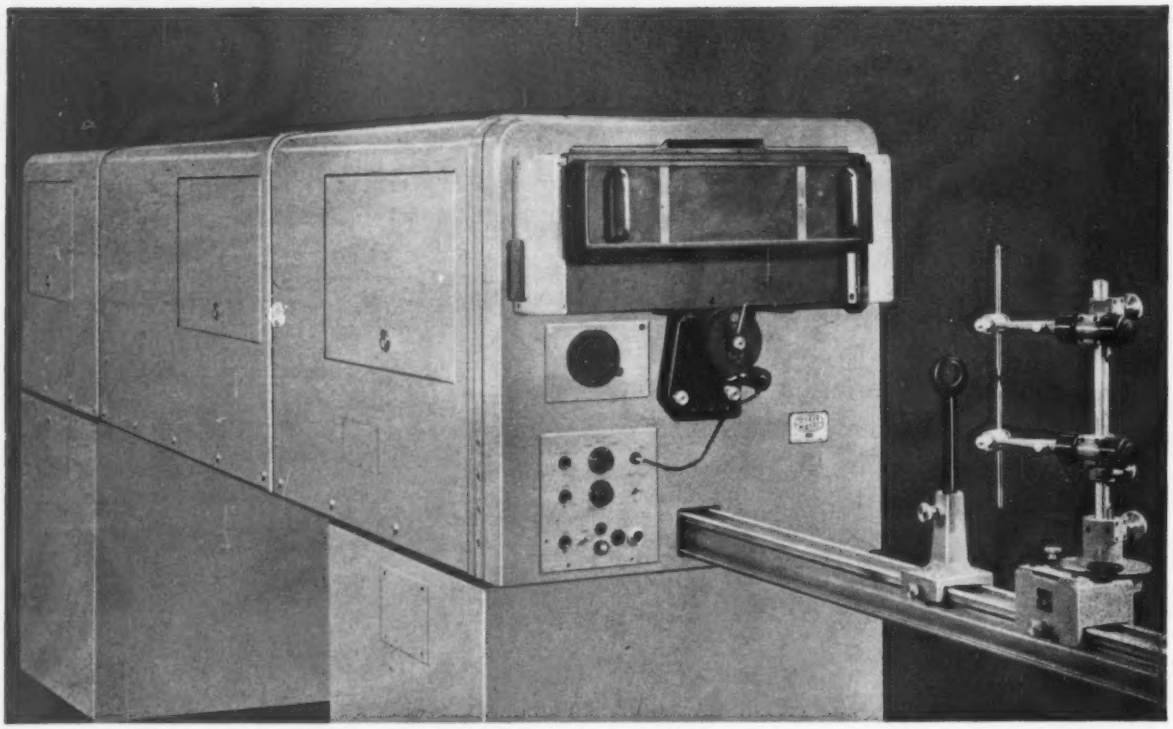

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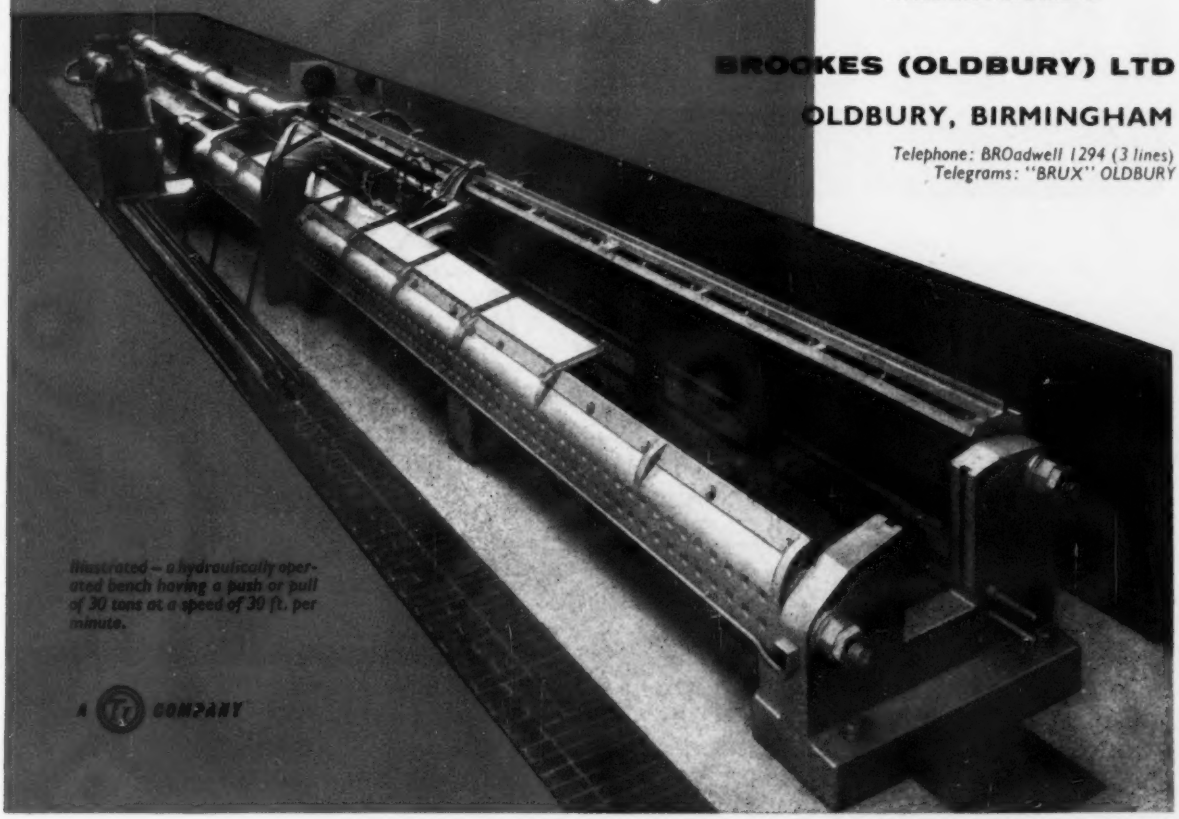

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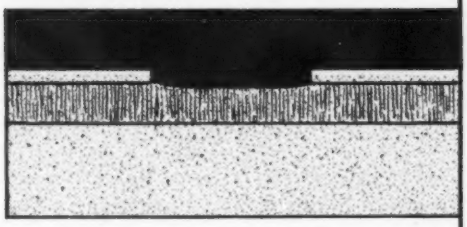

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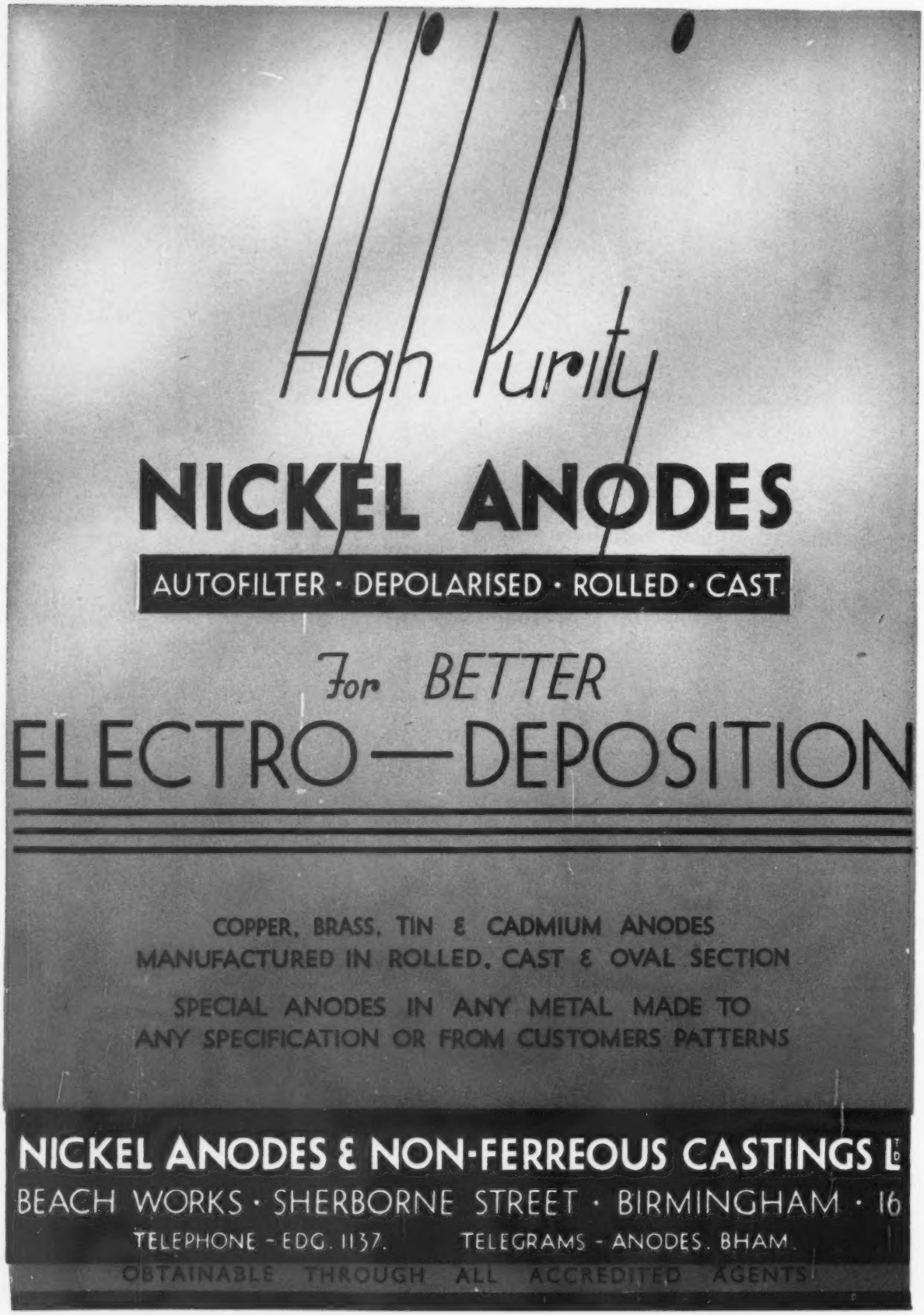
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Demand for Technicians

EMPLOYERS in the engineering and chemical industries in this country forecast earlier last year that the total demand for technicians in the next two years would, in most branches, be about twice the number of existing vacancies, which would represent an increase in current strength of about 16 per cent. In metal manufacture, the two-year demand was forecast as nearly four times the current vacancies, which would represent an increase in existing strength of nearly 20 per cent. In the shipbuilding section, however, many firms were doubtful whether any more technicians would be required in the next two years. These estimates were revealed in answer to a questionnaire completed by 400 firms in the two industries, which was sent to them by the Ministry of Labour in 1960, and the results were analysed in a recent issue of the *Ministry of Labour Gazette*.

The object of this survey was to gain information about the proportion of technicians to other workers employed in the industries concerned, the proportion engaged on different kinds of work, the qualifications held, and the present and future demand for them. As there is no accepted definition of a "technician", employers were issued with a memorandum in which the term was defined in a wide sense and gave guidance about the categories to be included. Enquiries were made of firms which together employ about 22 per cent of the total labour force in the two industries concerned (engineering and chemical). Nearly 18 per cent of their employees were engaged on managerial, administrative and clerical work, and 71 per cent were craftsmen, semi-skilled or unskilled workers. The results showed that technicians constituted 8·7 per cent of the employees, compared with 2·1 per cent who were qualified scientists and engineers. In other words, there were on average four technicians for every qualified scientist or engineer; in the chemical and oil refining industries the proportion was about 1½ to 1, and in the engineering industry rather more than 5 to 1. Only 4½ per cent of the technicians were women.

Industries showed considerable variations in the proportion of technicians to the total number of employees, and there were also variations between different firms in the same industry. The highest proportion of technicians, 11·6 per cent, was employed in the electrical engineering and electronic group, and the lowest in the miscellaneous metal goods, metal manufacturing and shipbuilding groups, 4·1 per cent, 4·4 per cent, and 5·5 per cent, respectively. About one-third of all technicians were employed in design and drawing office work, in which category there were 41 per cent of all current vacancies. The next largest demands were for laboratory technicians and for technicians to be employed on testing, inspection and analysis. The overall shortage, as a ratio of current vacancies to existing manpower strength, was 7·7 per cent, rather less than that of qualified scientists and engineers in these industries in 1959, when it was 9·6 per cent.

The survey also showed that nearly 14 per cent of technicians had a Higher National Diploma, or Higher National Certificate, or were members of a professional institution. Nearly 17 per cent had an Ordinary National Certificate or a City and Guilds Final or Intermediate Certificate. More than 59 per cent were reported as having no qualifications, although there would be included in this group many who had completed a full course of craft apprenticeship, and also technicians who were still studying for a qualification.

Out of the MELTING POT

Still Brass? "BRASS. — This is essentially an alloy of copper and zinc, but for special purposes small proportions of other metals are sometimes added to obtain increased strength, hardness or resistance to corrosion." This simple general definition of the term "brass" is broad enough to cover all the various known types of brass, with the possible addition of qualifying terms in cases where this is felt to be desirable. Whether the definition should be stretched still further is doubtful. Admittedly it may be comforting to call a somewhat unusual alloy composition by the familiar name of brass. There is also the advantage that one thereby avoids the need of trying to discover some other name for the alloy and running the inevitable risk of having the name criticized. This question of when a brass ceases to be a brass or to what alloys the term brass can be extended, arises with some force in connection with new low-zinc brasses announced in India. It is reported that brasses containing less than 50 per cent copper and little or no zinc are being tested at the National Metallurgical Laboratory at Jamshedpur, with the aim of developing sheet alloys that will minimize the use of scarce materials, notably copper and zinc (so much for the definition of brass). In place of these elements, as much as 40 per cent of manganese may be present. Such alloys, it has been found, can be hot and cold worked, and have excellent deep drawing properties. The manganese does, however, reduce the thermal conductivity. Tests to determine the best composition range of such alloys, and to study the effects of small additions of other elements, such as aluminium and nickel, are continuing. Wonderful material, brass.

Luck Confirmed LABORATORY experiments have only too often to be undertaken in a hurry for the purpose of discovering the cause of some difficulty or trouble encountered in practice. Understanding of the cause, it is hoped, will suggest means of overcoming or eliminating the particular difficulty. On such occasions, mention of the advantages of exercising foresight is perhaps better avoided. In any case, it must be remembered that this uncalled for sententious pronouncement does not take into account the element of luck. Unscientific though it is, this element does operate occasionally, allowing those who fail to exercise foresight to get away with whatever it is they try to do. This happened, for example, when motor car engineers started fitting cast aluminium alloy cylinder heads to water-cooled internal combustion engines. Even if they had ever heard of bimetallic corrosion, they most certainly failed to consider its possible incidence in an assembly of an aluminium alloy and an iron casting bolted together in the presence of quite an efficient electrolyte—the cooling water. Although they thus failed to exercise foresight, luck was on their side and, in general, no trouble arose. Instead of having to concern itself long ago with what would have been the fairly obvious cause of the trouble that should, theoretically, have developed, a leisurely investigation has only recently concerned itself with the cause of the unexpected luck. This cause has been found to lie in the variation of the electrode potentials of cast iron and cast aluminium-silicon alloy with the temperature of the electrolyte (the cooling water). After a short period of immersion at room temperature, the electrode potential of the aluminium alloy was found to become slightly more positive than that of cast iron. With rise in temperature, the potential of the cast iron remains unchanged, while that of the light alloy drops and at about 60°C. becomes more negative than that of the iron. At 100°C. the potential difference is considerable, and the resulting current causes a corresponding corrosion of the light metal. The process is reversed on cooling, the electrode potential of the light alloy again becoming slightly more positive than that of the cast iron. This behaviour, which depends on the presence of oxygen in the cooling water, means that bimetallic corrosion of the cylinder head occurs only when the cooling water is hot, i.e. when the engine is running. On the basis of an average running time of 100 days during the life of an engine, the reduction in thickness on the surfaces of the cylinder head exposed to the cooling water can be calculated from the current measurements to amount to about 0·3 mm. This, if uniformly distributed, should cause no trouble.

Errant News AGAIN and again, small items of technical information are discovered in circumstances that confirm once again that the ways of presenting, publishing and consequently discovering technical information are strange and unpredictable. An outstanding example of a situation of this type concerns the news of a set-up for melting aluminium, adopting the practice, used in type-founding, of gradually lowering one end of a long billet of the metal into the melt, and thereby keeping the level of the latter constant as molten metal is withdrawn for casting. How and where would you expect such information to be presented? It would probably merit a Paper or article on its own. In actual fact, it failed to make the grade and was merely mentioned in a Paper describing aluminium sand casting practice at the Pontiac Motor Division of General Motors Corporation. To complicate matters a little further, this Paper was presented at the First National Die Casting Congress organized by the Society of Die Casting Engineers and held in Detroit from November 8 to 11. Finally, the information was discovered among brief summaries of other Papers at the Congress published in a journal of metal working practice and machine tools. But to return to the information. The particular set-up using this continuous solid feed method comprises electric induction melting, holding and automatic pouring units capable of delivering 4 to 5 tons of aluminium per hour to a sand casting line, with a temperature variation of only 10°F. at the pouring spout. The melting stock, chosen to ensure high quality, consists of semi-continuously cast billets, 8 ft. long by 12 in. diameter. These billets are suspended from a hook cast in at one end, and are lowered into the melting furnace at a rate controlled by the quantity of metal delivered from the pouring spout. The entire operation of melting and pouring is carried out by one man with no special skill.

Skimmer

THEIR APPLICATION TO METALLURGICAL FAILURES IN AIRCRAFT

Investigational Techniques

By D. A. RYDER, M.Met., Dip.Phys.Met., A.C.T.(Birm.) A.I.M.

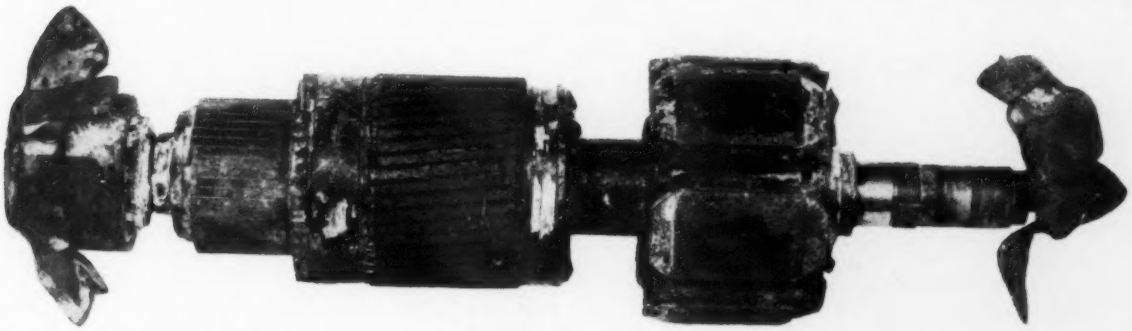
Analysis and diagnosis of service failures form a large part of the work of many metallurgists, and this Paper, originally presented before the North East Metallurgical Society, describes some examples encountered by the author at the Royal Aircraft Establishment Farnborough.

OVER one hundred types of failure were listed by George[1] in a survey of the whole field of metallurgical failures in aircraft. Even so, he described his classification as "only provisional and incomplete". No attempt will be made here to review so wide a field, but the techniques available to the investigator will be discussed and only the most important types of failure dealt with in detail. It is convenient to retain the two main sub-divisions of the George classification and describe failures as either non-fracture or fracture.

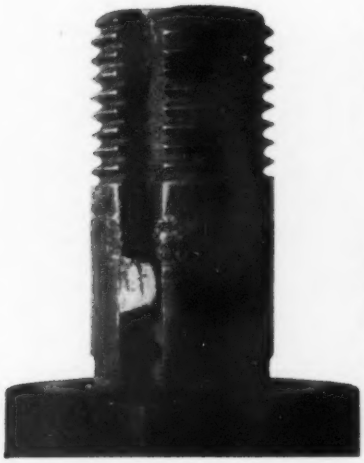
Non-Fracture Failures

In general, where a failure occurs without fracture, visual inspection and metallographic examination are the methods of investigation used. Corrosion, unsatisfactory heat-treatment, overheating, and many material defects can be readily detected by conventional metallographic techniques.

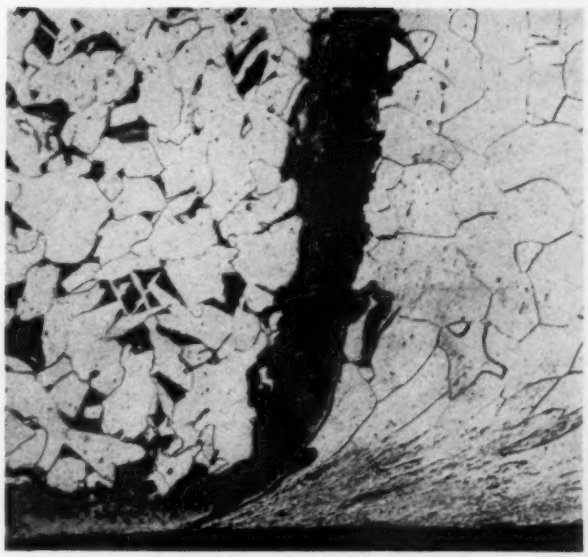
X-ray diffraction is also useful, particularly for the identification of small amounts of material. Many of the items examined may not be metallurgical failures at all, but rather components or assemblies which require metallurgical examination to clarify a particular point. An example is shown in Fig. 1, which shows part of an electrical generator recovered from the wreckage of an aircraft. It was important to know whether the generator was rotating at the time of impact. It was at first thought that if the generator had been rotating on impact there would have been evidence of rotational damage to the blades of the cooling fans at each end of the shaft. The examination was made more difficult by the fact that the specimen had suffered considerable fire damage. Examination showed that each fan was copper-brazed to a steel bush. The bush fitted over the generator shaft and was prevented from rotating with respect to it by a small steel pin passing transversely through the bush and protruding into a keyway in the shaft. The shaft with the keyway and a piece of the broken pin in position are shown in Fig. 2. A microsection through the bush showed that the surface of the bush in contact with the shaft had been heavily deformed and even locally re-crystallized. Part of this microsection is illustrated in Fig. 3,



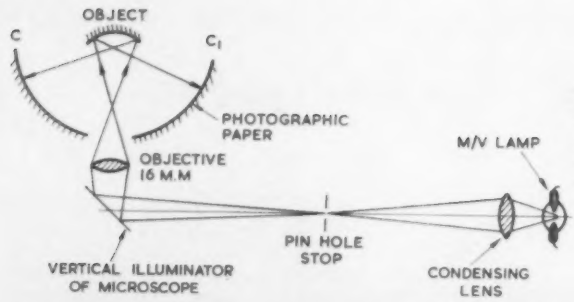
Above: Fig. 1—Rotary inverter showing damage to cooling fans at each end of the shaft



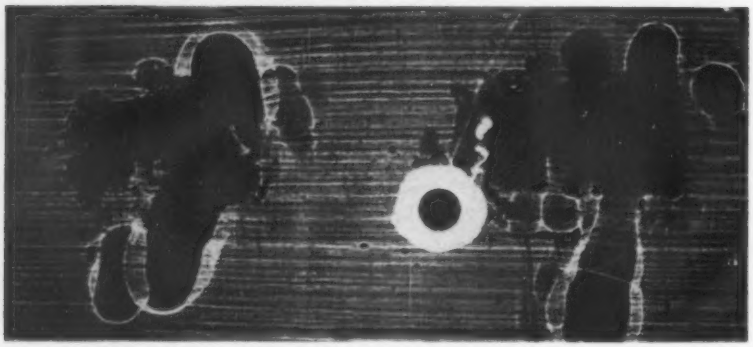
Left: Fig. 2—One end of the shaft shown in Fig. 1 with fan removed. The radial key which passed through the fan bush has sheared off



Right: Fig. 3—Transverse section through fan bush showing bush (left), copper brazed joint, and key. The severe deformation of the key after failure indicates that the bush has rotated with respect to the shaft. Etched 2% Nital (×250)

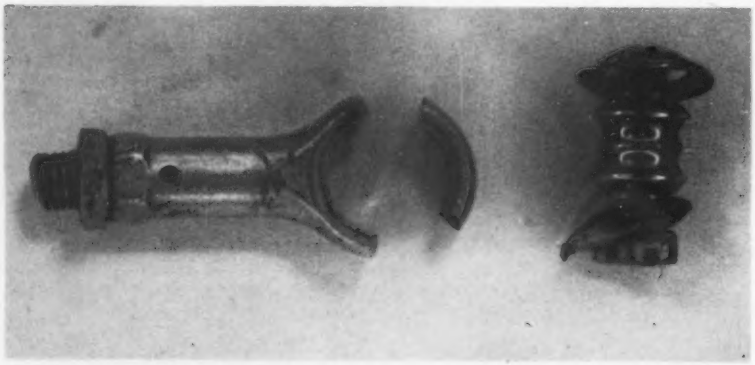


Left: Fig. 4—Diagram showing general arrangement of apparatus for the optical examination of small defects on curved surfaces



Above: Fig. 5—Brinelled ball race. The small circular marks were produced in service, the large dark areas were produced when the race disrupted. The central spot resulted from the hole in the film through which the incident light passed

Below: Fig. 7—Ball race linkage broken in service



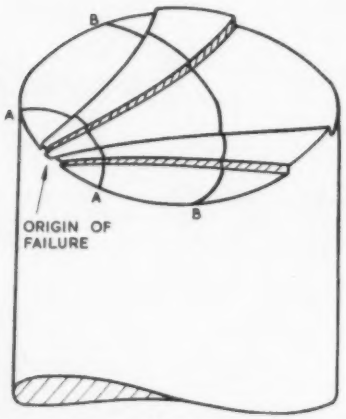


Fig. 6—The formation of a "fir tree" pattern on a fracture surface. AA and BB are successive positions of the advancing crack front

which shows the heavy deformation produced during and after shearing of the pin.

This evidence made it certain that the shaft was rotating at the time of the accident. The fan was probably stopped almost instantaneously on impact, but the shaft continued to rotate by shearing the transverse pin. Subsequent rotation of the shaft in the bush produced the deformation and recrystallization observed microscopically. This is a good example of the use of metallography in investigating an accident.

Occasionally, conventional metallographic techniques are not suitable for the solution of a particular problem, and it may be necessary to extend or modify them. A recent investigation involved the examination of the tracks of several self-aligning ball races that had been used as linkages in an aircraft control system. It was necessary to examine the tracks of the races for signs of Brinelling and to record the whole pattern of indentations. Examination by conventional microscopy was unsatisfactory because the surfaces were curved and the indentations shallow. The problem was solved by the use of the apparatus[2] shown diagrammatically in Fig. 4. A quarter section of the outer

Fig. 8—Fracture surface of specimen shown in Fig. 7 the "fir tree" pattern indicates that the fracture originated at "O" (×7)

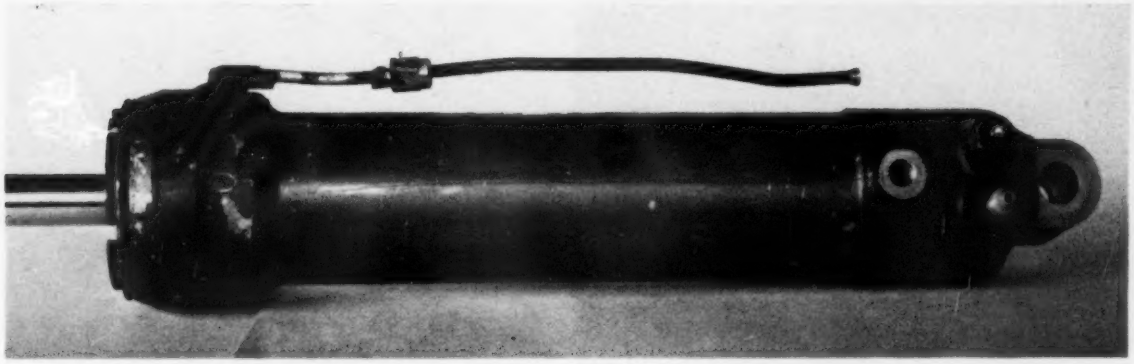


Fig. 9—Hydraulic jack cracked longitudinally

race was mounted above the stage of an inverted microscope and illuminated by the divergent beam from a 16 mm. microscope objective. The reflected rays from the specimen then formed a magnified image of the surface on a curved strip of film *CC*, (Fig. 4). Any small indentation on the specimen surface scattered the incident light so that the indentation did not contribute to the formation of the image, and therefore appeared as a dark patch. The camera was, in principle, the same as that used in the Debye Scherrer X-ray method, the incident light beam passing through a hole in the film which was itself attached to the inside of the cylindrical wall of the camera body. This method was used to obtain Fig. 5, which illustrates part of a ball race track. The large indentations are damage caused on final impact of the aircraft when the balls broke out of the race. Many very small indentations can, however, be seen between them. The technique is also suitable for examining convex curved surfaces.

The technique has the advantages of high resolution and unlimited magnification. The magnification does, however, vary over the image, depending upon the geometry of the specimen.

Failures Involving Fracture

The majority of failures in aircraft involve fracture of a component. In such cases, the first objective of the investigator is to determine the mode of failure, and to this end the interpretation of the evidence available on the fracture surface is of primary importance.

The techniques used are visual inspection, usually with a low power microscope, although examination of the fracture at the highest powers available may, as will be shown later, yield useful results.

Few engineers or metallurgists would have difficulty in recognizing a tensile failure that produced a cup and cone type fracture or a classic 45° so-called shear failure. Apart from diagnosing the fracture type it is often possible to find the point at which fracture began. The well known "fir tree" pattern or chevron marks are useful for this purpose. It is generally accepted that the apex of the chevron pattern indicates the point at which fracture began. Such markings occur when: (a) the crack propagates on slightly different levels; (b) the crack front lengthens as the crack spreads.

Their origin is illustrated diagrammatically in Fig. 6. Chevron patterns are not reliable indications of the origin of cracking in the case of certain fatigue failures, as will be shown later.

In cases where the diagnosis of the type of fracture is in doubt the simulation of the failure under laboratory conditions is obviously useful. A linkage from the control system of a helicopter, which consisted of a small, self-aligning race, with a spigot on the outer member, is shown in Fig. 7. Fracture had occurred across the outer member of the race, and one of the fracture surfaces is shown in Fig. 8. Fracture began at one corner (arrow O), as shown by the "fir tree" pattern, and spread in a brittle manner normal to the axis of tension. Final separation at the convex surface was by shear. The general appearance suggested a possible fatigue failure, but the possibility of tensile failure could not be ignored. It was found that the fracture could be almost exactly reproduced by fracturing a similar linkage in tension at a high rate of loading.

Stress Corrosion Failure

In recent years, a fairly large number of failures have occurred in aircraft components due to stress corrosion. Such failures entail fracture under the combined effects of stress and corrosion at a stress of lower magnitude, or in a shorter time, than would have obtained in the presence of the stress alone or the corrosive atmosphere alone. The extent to which corrosion alone is necessary in inducing failure is uncertain, but where cracking occurs in anything but vacuum, the term stress corrosion, rather than stress cracking, seems appropriate. So far as aircraft structural materials are concerned, the problem is of the greatest importance in the high-strength aluminium-zinc-magnesium alloys, although such failures are by no means confined to this alloy system. Stress corrosion failures occur most commonly in two types of component, those manufactured from forgings and those made from extrusions.

A typical stress corrosion crack in a

Fig. 10—Fracture surface of specimen shown in Fig. 9. The light region of fracture was produced by stress corrosion which originated at "O". Failure was probably influenced by the tip of the blind hole acting as a stress concentrator

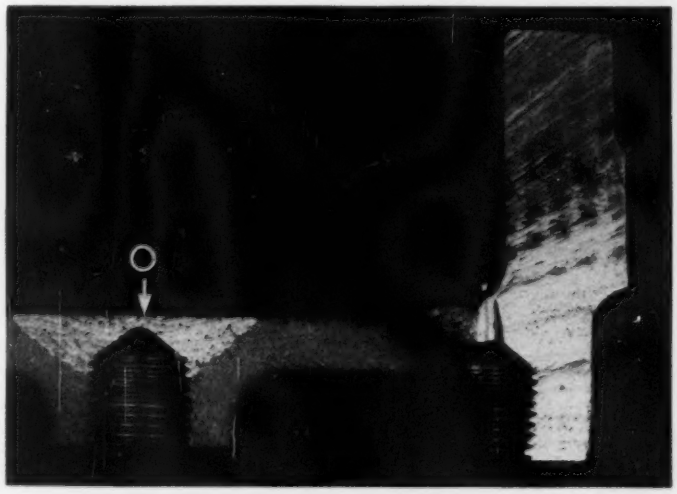


Fig. 11—Alternate dull and bright progression marks on the stress corrosion fracture surface of an aluminium-zinc-magnesium alloy forging. Failure originated at "O"

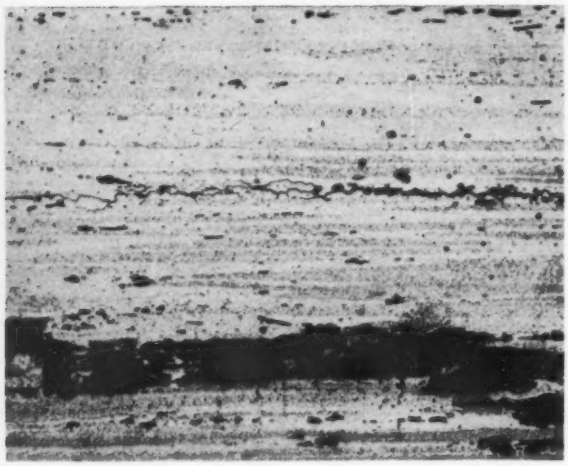


Fig. 13—Longitudinal microsection showing intercrystalline nature of the cracks and their relation to the marked fibre structure of the extrusion in Fig. 12. Etched Wassermans Reagent × 100

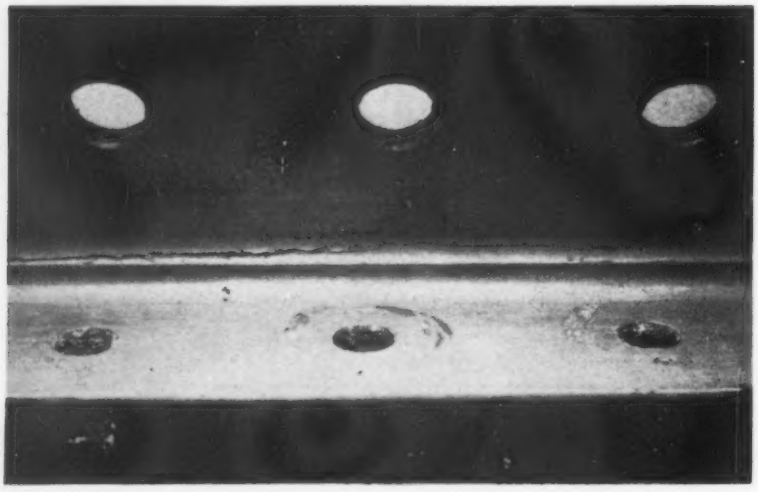
forged cylinder is shown in Fig. 9. Stress corrosion fractures in forgings exhibit the following characteristics which are useful so far as diagnosis of the failure is concerned :—

(a) Fracture most often follows the flash line of the forging; (b) the fracture is intercrystalline. (c) Fracture usually begins from some stress concentration; (d) alternate light and dark progression marks may be visible on the fracture surface.

The fracture surface of the specimen is shown in Fig. 10. The white area of the fracture is the intercrystalline stress corrosion area while the darker zones are transcrystalline fracture due to final separation under the influence of the applied and internal stresses. The fact that the phenomenon produces intercrystalline failure is not such a useful diagnostic feature as might at first be supposed. In the high-strength aluminium alloys, ordinary tensile failure sometimes produces intercrystalline fracture. Even with materials where tensile fracture is normally transcrystalline, the area of intercrystalline stress corrosion that initiated fracture may be extremely small. The presence of corrosion products on the fracture surface, particularly at the origin of failure is a useful diagnostic feature. Many service failures, however, have suffered general corrosion before examination.

The progression marks referred to in (d) may be confused with fatigue progression markings (Fig. 11). High residual macro stresses accelerate stress corrosion failure and in some cases failure has occurred under their influence alone, that is, with no externally applied stress. Stress corrosion in extrusions shows similar features, and cracking follows the fibre structure of the specimen. A crack of this type in an extruded channel is illustrated in Fig. 12. In this case, assembly stress had played a considerable part in the failure due to overtightening of transverse bolts which drew together the two legs of the channel. That the cracking was intercrystalline and followed the fibre structure of the extrusions is shown in Fig. 13.

Fig. 12—Longitudinal stress corrosion cracks in an aluminium-zinc-magnesium alloy extrusion showing discontinuous nature of the crack



The problem of stress corrosion cracking in forgings has largely been eliminated by improved manufacturing processes designed to reduce residual stresses. They are: (1) carrying out as much machining as possible before solution treatment; (2) reducing the severity of the quench; (3) step quenching.

The same measures are applicable to extrusions, and, in addition, stretching after solution treatment may be used to redistribute internal stress. Non-homogeneous deformation such as may be produced by certain stretch forming operations may result in higher local internal stresses. The elimination of the problem in extrusions is largely one of good design and manufacturing practice. The designer should avoid high design stresses transverse to the grain flow, and close tolerances should be held during assembly to prevent built-in stresses.

References

[1] C. W. George; *J. Birm. Met. Soc.*, 1947, **27**, 308.
[2] P. J. E. Forsyth and D. A. Ryder; Unpublished M.O.S. Report, Oct., 1958.

(To be continued)

Flow Measurement

SURVEYING the early history and subsequent developments of flow measurement by pressure-difference devices, a booklet published by George Kent Ltd., Luton, Beds., outlines the work of Venturi, Henschel and the more recent work of H. E. Dall. It describes progress in the design of meters and recorders, and is amply illustrated by diagrams and graphs. Appendices give a series of theoretical and mathematical data relating to flow measurement.

This booklet, of 52 pages, is priced at 10s.

Forming Techniques for Titanium Alloys

By J. PODY, B.Sc.Eng.
(*Hawker Aircraft Ltd.*)

(*Concluded from* METAL INDUSTRY, 6 *January* 1961)

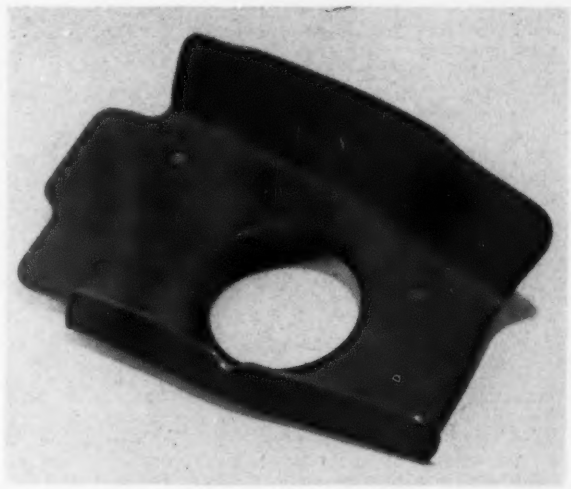


Fig. 10—Typical rubber pressed component

COLD forming of Ex. 011 may be carried out to a minimum $1\frac{1}{2}t$ bend radius provided that two major difficulties are overcome. The first is the stiffness of the material, resulting in a large degree of springback. Bend tests on this material showed a springback of about 13° on a 90° bend, but with a certain amount of coining on the bend line it is possible to reduce this to about 8°.

For a 90° angle on a finished component, considerable overbend is required with, in consequence, more expensive tools. Hand setting to the final angle has not been satisfactory, but as a final heat-treatment is required in any case, it is possible to combine this with a final sizing operation. Simple mild steel sizing fixtures have been made which constrain the component to the desired final form, while the whole assembly is immersed in a salt bath for the required ageing time. This was initially quoted as 16 hr., but recent information suggests that this may be reduced to only 2 hr.

The second major difficulty is the tendency of this material to gall on steel tools. This has not been completely eliminated, but the utilization of an extreme pressure lubricant, molybdenum disulphide loaded oils, hard chrome facing and polishing of the tool surfaces and regular cleaning of the tool to remove surface dirt or oxide traces from the blank, have all served to reduce it. The possibility of some form of surface treatment of the blank itself, such as anodizing, is currently being investigated.

A typical rubber pressed component incorporating a lightening hole and flanges with included angles of about 80° and 100°, and joggles in each flange, is illustrated in Fig. 10. After pressing, the flange was wrinkled where a close joggle was required; hand dressing was unsatisfactory owing to the stiffness of the material and its consequent tendency to "peak". The wrinkling was almost completely eliminated by scalloping the flange.

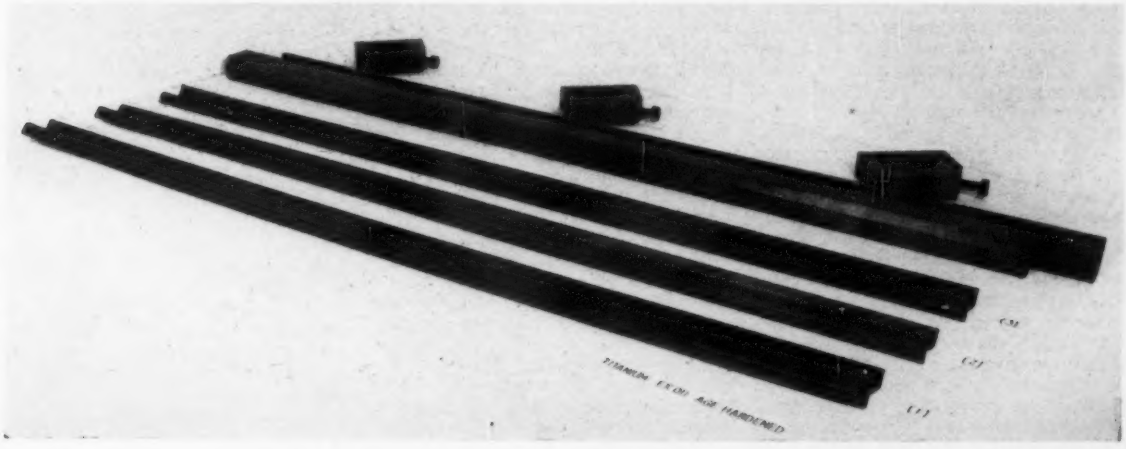
Three sections rolled and subsequently heat-treated are shown in Fig. 11. Two, unrestrained during ageing, exhibit twist and bow. The other, restrained in the simple fixture shown, was free from distortion when released.

Stretch-Forming Ex. 011

Physical tests on Ex. 011 show a 0·1 per cent proof stress of around 33 tons/in^2 and an ultimate tensile stress of around 48 tons/in^2. The proof/ultimate ratio is thus about 0·7. This ratio, in conjunction with good elongation (25 per cent), suggests the possibility of satisfactory stretch-forming. However, early practical tests on an Erco 150-ton stretch-forming machine showed that only 1 per cent elongation of the material occurred before the strip broke between the die and jaws, the resultant permanent set being negligible.

Further investigation showed that the form of the stress/strain curve above the 0·1 per cent proof stress was a slow increase of strain beyond the departure from the line of proportionality to a point near the ultimate breaking stress, at which the strain

Fig. 11—Rolled and heat-treated sections, with restraining fixture



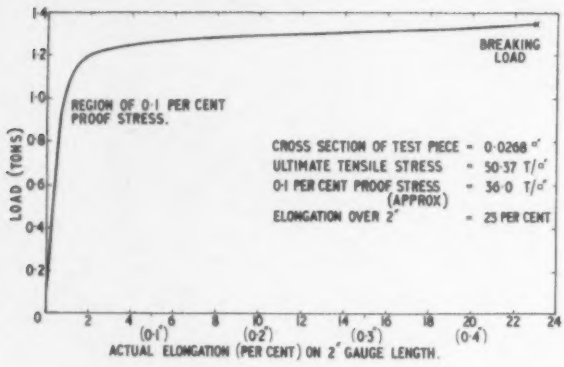

BREAKING LOAD
REGION OF 0·1 PER CENT PROOF STRESS.
CROSS SECTION OF TEST PIECE = 0·0268 sq"
ULTIMATE TENSILE STRESS = 50·37 T/sq"
0·1 PER CENT PROOF STRESS (APPROX) = 36·0 T/sq"
ELONGATION OVER 2" = 25 PER CENT
LOAD (TONS)
ACTUAL ELONGATION (PER CENT) ON 2" GAUGE LENGTH.

Fig. 12—Stress: strain curve for stretch-forming Ex. 011 alloy

begins to increase rapidly with little increase of load (Fig. 12). To produce the 5 per cent strain necessary for many complex components, the stretching stress would be very close to the ultimate tensile stress, and consequently die lubrication and a system of strain control assume maximum importance. These problems are now being investigated.

Material Descaling and Cleaning

The use of nitric/hydrofluoric acid solutions for acid cleaning has been established for both materials, 20 per cent nitric - 4 per cent hydrofluoric at 60° C. for 318A, 40 per cent nitric-8 per cent hydrofluoric at room temperature for Ex. 011.

When I.C.I. 318A has been heated in air for hot forming, or Ex. 011 in air for precipitation hardening, the scale formed cannot be removed satisfactorily in acid pickle. The most satisfactory method of descaling is grit blasting with aluminium oxide (Blastite No. 4 grade), followed by immersion in one of the above pickles.

After heating in a salt bath, e.g. 16 hr. at 505° C. for Ex. 011, acid pickle alone is sufficient to produce a clean surface.

Flatness of Sheet Material

Flatness requirements for sheet are determined by the purpose for which the material is to be used. For applications such as large skin panels, diaphragms, large frames, etc., any out-of-flatness which cannot be removed with moderate pressures is unacceptable. However, in applications such as small-formed and stretch-formed parts, out-of-flatness does not prevent forming of the desired shape.

Out-of-flatness in sheet may take the form of waviness, which can be removed by moderate pressure, or "panting", which remains in the sheet even under high pressure. Pants are caused by local stretching of the material and can only be removed by shrinking the sheet relative to the surrounding material.

Hence, moderate waviness is acceptable, whereas (except for small or stretch-formed components) panting is not.

In order that these different forms of out-of-flatness may be considered separately, a plastics vacuum blanket has been constructed which pulls the sheet down to a flat-surface table. This eliminates waviness but cannot pull down a pant. By means of a beam carrying a dial indicator, the height and extent of these pants may be measured relative to the flat sheet datum.

Based upon experience of the 318A and Ex. 011 alloys, it appears that these materials could have a useful place in aircraft structures.

Due to the difficulties involved in hot forming, the use of 318A is suggested where the form is comparatively simple, such as on large skin panels, diaphragms containing lightening holes, and sections where a 5*t* bend radius is acceptable.

Ex. 011 seems suitable for many small parts of more complex shape, but it should be remembered that this alloy requires heat-treatment after forming, not only to obtain the stronger properties, but also to stabilize the material.

Sampling Metals and Residues

By F. L. JAMESON, A.M.I.M.M.
(*Chief Chemist, Essex Metallurgical*)

ALTHOUGH great stress is, of necessity, laid on care and accuracy in the laboratory, the preparation of samples submitted for assay frequently leaves much to be desired. This arises from the fact that, in many works, the samplers work to a set method for very different materials, without due regard to their chemical composition. Unfortunately, this is also occasionally true of some outside samplers, who are called upon to represent the supplier. As a result, the chemist very often has to test samples on which it is practically impossible for him to obtain concordant results—and he is usually blamed for any differences with the works.

On simple materials such as brass or gunmetal ingots it might be thought that no problem can arise. A parcel, however, can be made up of a number of "heats", the composition of which can vary considerably. Even on a single heat the first ingot poured is unlikely to have the same copper content as the last.

In spite of this, particularly on the Continent, the sampler is content to take drillings from 10 per cent of the ingots, carefully screen them, and seal up samples containing "gross, mittel, and feines" portions. The fact that the drillings are not of uniform composition does not occur to him. A sample was recently submitted to the writer, consisting of a mixture of Monel metal and stainless steel drillings, no attempt having been made to separate the different materials with a magnet. In the case of non-ferrous ingots, the drillings obtained must always be melted into one ingot, using a suitable flux such as borax/cyanide mixture to ensure complete recovery of values.

Tin, lead and zinc residues with a high chlorine content are almost always deliquescent, and unless care is taken while they are sampled they will pick up moisture faster than the chemist can weigh up his charges. In many works it is the usual practice to treat the sample with a measured quantity of soda ash and dry in the oven before grinding. This method is rarely effective, since it is necessary to cause a chemical change to take place (i.e. $ZnCl_2 + Na_2CO_3 = ZnCO_3 + 2\,NaCl$). This is unlikely to happen at oven temperature on relatively dry material, and even where it does the varying densities contained in the mixture make segregation almost a certainty. The following procedure has been found very satisfactory for deliquescent materials:—

A suitable quantity of the sample—say 1 kg.—is weighed out and heated in a ladle with a boiling saturated solution of soda ash—a little at a time being added with constant stirring. The amount of soda added is not important, provided it is sufficient to convert all the chlorides present to carbonate—20 per cent is usually more than adequate. After drying, the material is ground to pass the 60 mesh sieve, in the usual manner, and a perfectly dry homogeneous fines product will result.

Caustic soda residues arising from

lead refining are also very deliquescent, but for different reasons, and must be treated by other methods. Some Continental samplers use lime to dry out the material, but this is rarely, if ever, satisfactory.

With this material it is necessary to convert all the NaOH present to carbonate, and the obvious way to do this is to treat it with sodium bicarbonate (i.e. $NaOH + NaHCO_3 = Na_2CO_3 + H_2O$). Equal parts of the sample and bicarbonate should give satisfactory results, since a large part of the material will probably have been converted to carbonate on weathering, prior to delivery at the works.

Inadequate grinding of samples is also a frequent headache for the chemist. Samples of refining materials, drosses, etc., comprising metallics and fines portions, are submitted to him, and he finds that the latter portion has been prepared on, perhaps, a 30 mesh screen, and contains a large proportion of coarse metallic particles. The chemist can, of course, regrind the fines and weigh out proportions of, say, +60 mesh and −60 mesh, but it will indeed be fortunate if the duplicate sample, being tested by the works, contains the same proportion.

The suggestions outlined above may involve a little more time being taken in sampling materials at the works. It is certain, however, that this loss will be more than compensated in the laboratory and result in quicker settlements and fewer reference assays.

De-stacking Ingots

By J. D. HARRIS

THE problem of ingot casting and its relation to stacking, dealt with in an earlier article (see METAL INDUSTRY, 25 November 1960, p. 443), has recently been studied at Joseph Lucas (Electrical) Ltd. from the other end—that is, automatic de-stacking for melting prior to use in die-casting machines. To do this, the shape of the ingot has been changed and the suppliers are now providing the metal in this new manner, shown in the accompanying sketch and illustrations.

At first sight there are seen to be disadvantages in this method, and it is worth while considering them against the advantages.

The pack, which consists of two edge-on stacks high, is lighter than is normal, due to the length limitation of a standard fork truck. This is a pity. It could be overcome by non-standard forks on the truck if sufficient quantity made this worth while.

The amount of banding strip is increased over the normal pack. However, with certain unloading methods, the use of only four bands has proved to be practicable, and also strong enough for intermediate stacking and transport.

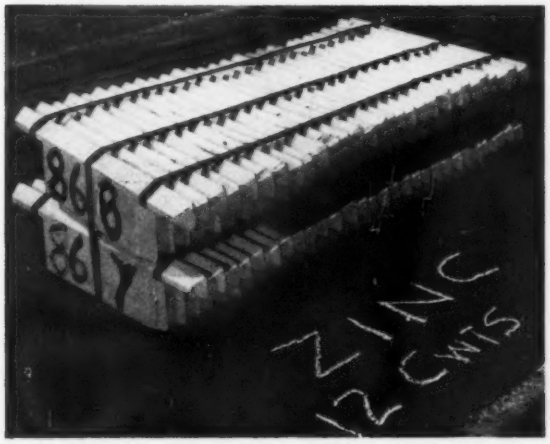
The main advantage is the ease with which this pack can be progressively used by putting it on a conveyor and inching forward to off load, without intermediate handling.

Stacks of ingots, demonstrating increased height to which they can be stacked

It seems likely that automatic stacking would also be much easier with this pack than with the normal cross-loaded pack.

A surprising advantage is the increased height to which these packs can be stacked with complete safety and obvious tidiness. This would be of great significance to those handling large quantities of metal.

A small additional point is that there is no non-standard foot ingot. All ingots in the pack are the same size and shape. This simplifies ingot pack building and the automatic unloading problem.



Left: Single 12 cwt. double-layer pack of ingots

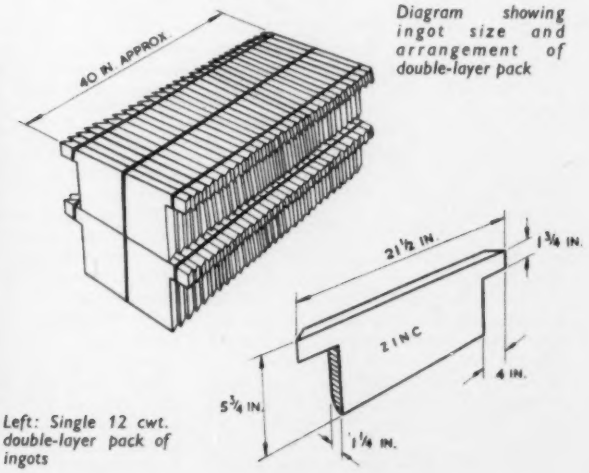


Diagram showing ingot size and arrangement of double-layer pack

CENTENARY OF PUBLICATION OF MAJOR BRITISH WORK

A Classic Text on Metallurgy

By M. SCHOFIELD, M.A., B.Sc., F.R.I.C.

AMONG the New Year's centenaries relating to metallurgy, that of the publication of the first volume of Percy's "Metallurgy" is most noteworthy. John Percy's work became a classic without equal in the English language, providing the answer to his own complaint that, in contrast to Sweden and Germany, our own country had provided up to then a scanty literature. Agricola and Kersten had led the way in such countries abroad; yet although British metallurgists were skilled in their applied work, they failed to publish books or major works.

On the anniversary of his volume on copper, zinc and brass, with fuels and fireclays thrown in for good measure, it is worth noting how this one-time medical man turned to metallurgy and to writing a four-volume text. John Percy was a solicitor's son who attended chemistry lectures at Nottingham and wanted to be a chemist himself, yet was constrained to become a doctor. But while in Paris taking a preliminary course in medicine before going to the Edinburgh medical school, Percy went to lectures by Gay-Lussac and Thenard, two eminent chemists who influenced him in this craze for chemistry. The influence is to be seen in his book, with considerable detail devoted to chemical aspects of metals as well as to metallurgical operations.

One of his first Papers was concerned with the sodium thiosulphate process for silver extraction, a process which became later modified to the von Patera process in Europe and the Russell process in America. Percy took to metallurgy when inspired by seeing the metal industries in Birmingham during his wanderings while he was a doctor at what was then the Queen's Hospital in the Midland city. At the age of 29 he was studying crystallized slags in association with D. Forbes and W. H. Miller, while a year later, in 1847, he was elected a Fellow of the Royal Society.

In his classic book, Percy almost apologises for being a doctor of medicine and yet writing a metallurgical text, for having studied the subject for only twenty years before beginning his writing. Yet he need not have done so, for Dr. Roebuck of Steelhouse Lane, Birmingham, changed chemical history overnight with his discovery of the lead chamber process for sulphuric acid, while a second Birmingham doctor who turned to chemistry and metallurgy was John Wright, inventor of the cyanide bath for electroplating and a leading light at Elkingtons.

When the call came to John Percy, he became lecturer (and later professor) of metallurgy at the School of Mines in Jermyn Street, the forerunner of the Royal School and then of the South Kensington College. Metallurgy was, in those days, an empirical art, yet Percy, during his many visits to works, was accumulating a basis for exact scientific explanation of techniques. He was to count many famous English metallurgists among his pupils, and he brought considerable influence to British metallurgy during his fruitful period. He discovered aluminium-bronze, accumulated a vast amount of material for his volume on copper, zinc and brass, yet he benefited ferrous metallurgy, as was to be expected, in times when Birmingham was the scene of advances in this branch.

Thus, one notes how Percy was associated with dephosphorizing of steel, with the first serious survey of our national resources in iron ores, and how, in 1861, the year of publication of his non-ferrous text, he was secretary to a War Commission on iron for defensive purposes. In 1876, Percy was awarded the Bessemer Medal, while in later years he retired to further studies when he objected most strongly to the move from Jermyn Street to South Kensington.

Turning now to the 1861 volume, one finds an absorbing survey of the position a century ago as regards non-ferrous metallurgy. In his first section, on general metallurgical processing, are details of smelting, roasting, reduction, fluxes and slags; in a second one come fuels, naturally including wood charcoal, with coke following and with references to the transition to coke from times when Dr. Plot and Jars described seeing the "charking of coales". Then, after a section on refractories and crucibles, come the full surveys of copper and zinc, with invaluable pages on copper smelting in Britain in its heyday. It is all carefully summarized, from the finding of the Llandudno cake of copper with its inscription: "To my partner in Rome", to Keswick in Elizabeth's reign with a few thousand copper miners at work. Yorkshire copper, Staffordshire copper, and the rival copper imported from Sweden; then a wealth of material on Swansea and Cornish copper, yet with little mention of the famous Parys and Glasdir mines. After discussing the vast quantities of sulphur dioxide thrown into the Swansea atmosphere, Percy foresees the combination of copper smelting and sulphuric acid manufacture rather than the call to build high stacks to throw such fumes clear of Swansea — but on to crops further afield.

Copper smelting in Chile and in Sweden, the coming of blast furnace smelting, the use of reverberatory furnaces and of poling: all are reviewed to provide us in 1961 with a picture of happenings a century ago. There is a shorter section on brass, beginning naturally with Birmingham and those "wealthy persons" in the Midland metal metropolis who were "monopolists acting in an impolitic manner and overreaching themselves". Then, quoting historian Hutton, we hear how these "brazen sovereigns" had such a "dangerous influence" on Birmingham! There is the coming of Muntz metal for sheathing ships in times when anti-corrosion was in its infancy. With his zinc section, Percy develops the historical theme from Valentine's time or earlier, and continues to Champion's leading role, the scene now changed to Bristol. Then on to zinc extraction, with Silesian, Belgian and Carinthian techniques, and the assaying of zinc ores.

As postscript to this commemoration of Dr. Percy as versatile metallurgist, a note on his role in aluminium history serves to illustrate his practical ability and his close interests in metal extractions involving much chemistry. Deville in France, in the eighteen-fifties, had made aluminium production by sodium displacement very much a French affair. Yet Percy, at the Jermyn School of Mines, had his two assistants, Allan Dick and Richard Smith, experimenting on the reduction of cryolite by sodium in place of Deville's double chloride of sodium and aluminium. Deville had been fortunate in having royal backing; in Britain, any enthusiasts in producing aluminium had to go it alone. In March, 1855, some globules of the metal had been prepared by Percy's method, rolled to slivers of foil, and these were shown by Faraday in the lecture theatre of the Royal Institution — specimens which are now in the South Kensington Science Museum. This was the first British effort in aluminium-making, a few years before Gerhard began his uneconomic venture at Battersea.

Obituary

Mr. E. F. Watson

WE regret to record the death of Mr. E. F. Watson, a director of Efco Furnaces Ltd. Mr. Watson joined the Electric Resistance Furnace Co. Ltd. in 1933 after serving an apprenticeship in the heavy engineering works of John M. Henderson and Co. Ltd., of Aberdeen. He was for many years sales manager, and was appointed to the board in 1955.

SOME EQUIPMENT BEING SHOWN AT THE PHYSICAL SOCIETY EXHIBITION

Scientific Instruments and Apparatus

ONE of the most important exhibitions of the year to be held in London is that which has hitherto been organized by The Physical Society with considerable success. The exhibition, which will open on Monday next, will, however, be under the auspices of **The Institute of Physics** and **The Physical Society,** both bodies having amalgamated since the last exhibition was held.

The venue is, as usual, the Old and New Halls of the Royal Horticultural Society, at Westminster, London, S.W.1, and the exhibition will remain open until Friday, January 20. We are not able to give a detailed review of the exhibition, but below is a short résumé of some of the products which will be on view. Figures in brackets after each exhibitor's name indicate the stand numbers.

Associated Electrical Industries Ltd (131). The research department at Manchester has made a study of the cathodic etching of metals. The erosion of the cathode in a glow discharge by positive-ion bombardment has been described as cathodic etching, since the cathode may show a structure after bombardment similar to that produced by conventional chemical etchants. The cathodic etching apparatus exhibited is simple in design and straightforward in operation and, with the exception of a small gas cylinder and rotary vacuum pump, is self-contained in a standard table-mounting instrument cabinet. Toxic and radioactive materials may be safely etched, and the ease of operation makes the apparatus very suitable for use in a routine metallographic laboratory.

Baldwin Industrial Controls (127). One of the exhibits on this stand will be a wire welder. This capacitor discharge welding apparatus was developed originally for the production of thermocouples. The basic unit welds wires from 0·0005 in. to 0·020 in. diameter, but with supplementary units the range is extended to cover all wires from the finest to approximately 14 gauge.

R. and J. Beck Ltd. (93). Two items will be of interest on this stand. The first is a micro-hardness testing microscope. This instrument is a modified metallurgical microscope designed in collaboration with Associated Automation Ltd. to accept the G.K.N. micro-hardness testing apparatus. The microscope has the normal basic features of a metallurgical instrument and can be used for many types of investigation without removing the hardness testing unit.

The second exhibit is a photomicrographic bench. The equipment provides a complete apparatus of the horizontal type carried on two triangular section optical benches. The camera is a triple extension whole-plate unit to which may be coupled microscopic or macroscopic stands and illuminating trains using a high intensity ribbon filament light source. With the appropriate accessories a complete range of magnifications from ×1 to greater than ×1500 can be achieved.

British Iron and Steel Research Association (53). The measurement of strip speed is one of the problems which has occupied the attention of the association, which is developing a new method in which two photocells are set on two illuminated spots on the strip surface, the two spots being a fixed distance apart and lying along the passline. Small irregularities in the light reflected from the strip surface give rise to a pattern in the output of the first photocell. After an interval of time, depending on the distance apart of the two photocells and the strip speed, another similar pattern appears in the second photocell. Thus, if the output of the first photocell is delayed (e.g. on a tape recorder) and then added to the second photocell signal, a maximum combined output will be obtained when the delay time introduced is equal to the time for passage of a point on the strip surface between the two photocells. From this delay time, and the known distance between the illuminated spots, the strip speed can be readily calculated.

Cambridge Instrument Co. Ltd. (54). Among new instruments being exhibited by this company is the Microscan X-ray analyser. The technique of X-ray microanalysis consists essentially of focusing an electron beam on to a region of the specimen surface approximately 1μ in diameter and slightly less in depth and analysing spectroscopically the resulting X-rays. This instrument allies this basic technique with scanning facilities so that it can display, side by side, an X-ray image showing the distribution of a particular element over the area scanned and an electron image formed by reflected electrons from the same area. This latter is comparable to an optical micrograph. The magnification can be controlled from about 200 to 3,000, and the resolution for both images is normally about 1μ. The accuracy, for static-probe quantitative analysis, is normally ±1·0 per cent or ±0·1 per cent, depending on the form of read-out. The instrument can analyse elements ranging from uranium (92) down to magnesium (12).

The examination of thin metal foils by transmission electron microscopy is an increasingly important metallurgical technique. For some applications possibly the only way to prepare foils thin enough to show up their detailed sub-microscopic structure is by cutting them with an ultra-microtome. The Huxley ultra-microtome, fitted with a diamond knife, is stated to be ideal for the purpose. All the mechanisms of the instrument are mechanical in operation, and the force for the cutting stroke is provided by gravity. The rate of fall of the specimen past the knife can be adjusted to give the best speed for any type of specimen from soft biological tissues to hard materials like metals. Sections of metals down to 100mμ can be cut successfully.

Dawe Instruments Ltd. (118). Of particular interest on this stand is a small, fully transistorized equipment in which the generator and tank are housed in one compact unit. Controls consist of two on/off switches, and an integral heater and thermostat are featured. The temperature of liquid in the tank can be as high as 93° C. without damaging the transducer. Power output: 80 W peak, 40 W average; frequency: 25 kc/s.; tank volume: 3 pints.

Edwards High Vacuum Ltd. (116). Among the many items exhibited by this firm is a high vacuum coating plant. Originally developed for applications in research, this coating unit—the Speedivac 6E2—a miniature unit, with its 6 in. diameter work chamber, has been redesigned from extensive field experience gained with the model 6E units, and incorporates most of the refinements found in large-scale apparatus. Attention has been given to ensure maximum access to all components, both for ease of servicing and to provide maximum versatility as an instrument of education, research and development.

Griffin and George Ltd. (123). A number of interesting items are being exhibited by this group, including the Griffin oscillating hotplate (Fisher pattern). This is a combination of hotplate and oscillating unit which enables the heating and agitation of liquids to be effected simultaneously, thus accelerating such processes as metallurgical and chemical analyses, determination of potash in fertilizers, acid values of fats, etc., and obviating the tedium of the manual work.

Hilger and Watts Ltd. (133). A new instrument from this company is the Ultrascan double-beam recording spectrophotometer, which is useful for routine analysis in the range from 200-750mμ. Resolution is 0·1mμ at 250mμ and 0·2mμ at 500mμ. Two light sources are used, one for the ultra-violet region and one for the visible region. These are a hydrogen lamp and a tungsten filament lamp respectively, and they change over automatically at 350mμ where their spectra overlap, enabling a complete scan to be taken right through the range without a break. The flat-bed recorder has three scanning speeds. Spectra are plotted linearly in frequency on charts calibrated in wavelength. The ordinate scale is linear in density or transmission, and can be expanded to provide for low transmission or high density values. English, French and German charts are available. Specimen cells have pathlengths ranging from 1-100 mm., and many accessories are available for continuous flow measurement, chromatography, flame spectra, etc.

Metals Research Ltd. (95). This Cambridge firm has several items of interest on its stand. The Pyrotube is an entirely new type of high-temperature heating element capable of heating furnaces to 1,800° C. The element consists of a molybdenum heater which is sheathed by a pure recrystallized alumina tube. The impervious sheath is sealed at the lower end and closed at the top by an appropriate header which contains the electrical terminals and the connections for the protective gas supply. Cylinder hydrogen is used at very small flow rates to prevent oxidation of the molybdenum, and is confined within the Pyrotube. The heated zone starts 3 in. from the bottom and extends upwards for 6 in. or 12 in. in the two standard types. These robust, easily replaceable elements are capable of heating furnaces to 1,800° C. in oxidizing or reducing atmospheres. The

very low silica content (0·02 per cent) of the sheath eliminates contamination of the charge.

Many types of metallic single crystals are exhibited, including those grown by Bridgman, Czochralski, strain-anneal and floating zone methods. Many of the crystals are seeded to produce the required orientation and others have been spark machined to produce strain-free specimens to close dimensional and crystallographic tolerances, e.g. picture-frame specimens in the principal crystallographic axes for magnetic measurements; specimens for tensile tests and specimens for ultrasonic measurements of elastic constants, etc.

The Servomet spark machine is an adaptation of the spark erosion process for use in metallurgical laboratories. This instrument has been used extensively by Metals Research and is said to have proved an invaluable means of rapid, accurate and strain-free machining of all types of metallurgical specimens. Among the features of the Servomet which make it especially useful for laboratory use are the following:—(1) A specially rapid response tool-feed servo-system to prevent contact between tool and work which would introduce strain in crystals being machined. (2) A slotted disc tool for the preparation of very flat smooth surfaces which need only a light diamond finish or electro-polish to be ready for metallography. (3) A sensitive servo amplifier to allow automatic operation on the very fine finishes required for preparation of metallographic specimens. (4) An automatic timing sequence reducing the energy of the spark regime at appropriate time intervals. This allows the preparation of metallographic specimens to be largely automatic. (5) The Servomet has a range of toolholders and workholders suitable for most laboratory work, and is very compact.

Morgan Crucible Company Ltd. (36). The exhibits displayed on this stand illustrate some of the techniques and materials developed by this group of companies. New couple elements are being developed for peak temperatures in the range 1,600° C. to 2,000° C. or higher, in which conventional metallic couples fail. Some of the materials, being semi-conductors, provide a very high voltage output compared with metals. For example, a silicon carbide-graphite couple can be made to give 0·2 volts at 1,000° C. Modification of the properties of silicon carbide and graphite, by controlled adjustment of composition, allows couples to be made from two types of silicon carbide, or two types of graphite. Alternatively, any of these materials can be run against a refractory metal such as tungsten or rhenium.

The "Crusilite" silicon carbide electric heating element has been adapted to produce a heater for sealing transistor envelopes or other small electric components. The component to be sealed is placed in the centre of a small ring heater, providing a concentrated source of heat radiation to the required area.

The dynamic electronic furnace analogue model demonstrates the ease with which a complicated furnace design can be modelled electronically. Many of the refinements of large analogue computers are omitted, but the model can take into account the heat flow through the various assemblies of refractory insulation in the walls, roof and doors of the furnace. It can also allow for storage of heat in the walls, and the very large losses of heat in exhaust gases. The model will provide information on fuel input and on the working temperatures at any point in the refractory walls by automatically following a speeded-up version of the full-scale cycle.

Nash and Thompson Ltd. (40). Several items will prove of interest to visitors to this stand. The Nashton vibratory polisher is said to polish any number of specimens from two to eighteen in one loading. The polisher will operate with no attention and specimens can be polished overnight. This equipment is designed to reduce the labour content of specimen preparation. Specimens are placed on the abrasive surface and loaded with the weight, the vibratory motion of the table top developing a polishing action which, at the same time, rotates the specimens. Specimens can be polished to a finish for electron microscope examination.

Based on the principle of the interference of eddy currents by the basis metal, the Accuratest thickness tester will measure non-conducting finishes on non-ferrous bases in the range of 0·0001 in. to 0·005 in. with an accuracy to ±10 per cent.

An electrolytic polisher enables the surface structure of the metal to be removed by electrolysis, and is ideal for single and multiphase alloys where physical polishing can cause work hardening. The equipment consists of a heavy duty power pack and a swirl head assembly into which the specimen is mounted and subjected to an applied potential while the surface is in contact with a continuous flow of electrolyte.

W. G. Pye and Co. Ltd. (100). Essentially similar in circuit design to the industrial *p*H amplifier "D", the "Dynacap" *p*H meter and millivolt meter incorporates a dynamic capacitor to achieve exceptionally high zero stability, linearity and accuracy. Basic scaling of the meter gives two main ranges of 0-10 and 0-14 *p*H units on a 5-in. scale; these can be expanded to give an effective scale length of 35 in., each division then being 0·02 *p*H unit. The two main ranges and the sub-ranges, of 0-2 *p*H, 2-4 *p*H, 4-6 *p*H, etc., may be selected rapidly by using only one switch. Both fully automatic and manual temperature compensation are incorporated. The millivolt ranges are 0-1,000 mV and 4-1,400 mV, with expanded ranges of 200 mV each throughout the full range of 0-1,400 mV. Recorders and other external devices to a series resistance of 10 kilohms on the main ranges and 5 kilohms on the sub-ranges may be used.

Telcon Metals Ltd. (26). Among the exhibits shown on this stand are included those concerned with magnetic alloys. Phenomenal advances made in the soft magnetic materials field include (a) Supermumetal, in which initial permeability has been further raised to 150,000-200,000, with a maximum permeability in excess of 500,000; (b) Super-Radiometal. The initial permeability attained (12,000-15,000) is five times that of the standard alloy, and the maximum permeability, in the range 100,000-140,000 shows a similar factor of improvement; (c) Supermendur. This material has a rectangular hysteresis loop and a maximum permeability of 70,000-80,000, at least ten times that of the standard alloy.

Techniques have been devised to facilitate utilization of the enhanced characteristics of the soft magnetic materials. These include :—(a) Assembly of thin laminations into cores by a block system. Laminations are stuck together, when insulated, in blocks of 2, 3 or 4. This minimizes damage to thin laminations of soft material and speeds the assembly of cores; (b) Stacking factors in excess of 98 per cent, obtained by a new process of insulation. This gives improved magnetic performance or may be applied to attain reduced dimensions of components; (c) Improvements in bonding and cutting methods. These have facilitated the production of cut cores in nickel-iron alloys with minimum reducton in magnetic performance; (d) Bobbin cores. Using Mumetal tape of about 3 microns thickness wound on ceramic bobbins, cores down to 2·5 mm. diameter have been produced for use as computer elements.

The Thermal Syndicate Ltd. (44). Specially featured on this stand is "Spectrosil", a synthetic fused silica which is being used in increasing quantities not only in apparatus where extreme purity is required but as an ideal material for optical work at high temperatures and in the ultra-violet spectrum. Because of this, the company have decided to discontinue manufacture of their previous optical grades OG and OH, and to use Spectrosil for all optical components.

Spectrosil "B" is a good general optical material, superior to the previous OG and OH grades in homogeneity and transmission characteristics. It is recommended for general work in the ultra-violet region and for ultrasonic delay lines. Spectrosil "A" is a similar material but is manufactured against a strict specification for transmission characteristics, permissible refractive index variation and presence of bubbles. Details of this specification are available. Examples of the forms in which these grades can be supplied will be exhibited.

Ultrasonoscope Co. (London) Ltd. (82). A new addition to the Ultrasonoscope range of ultrasonic flaw detectors is the General Purpose Flaw Detector Mk. II, which replaces the existing Mark IB portable instrument, incorporating many additional facilities and improvements. Particular efforts have been made to meet the requirements of all those engaged on ultrasonic inspection, whether on the workshop floor, on open site, or in the research laboratory. To this end, several features not usually found in a portable flaw detector are incorporated. Very fast time-base speed and high trace brightness combine with a rectified or unrectified trace display to enable a comprehensive study of flaw echo shape. The operational frequency range of ½-10 Mc/s and a maximum depth range of 20 ft. (in steel) extend the possible application range over a very wide number of non-destructive inspection problems. A 5 in. diameter high definition cathode ray tube reduces operator's viewing fatigue.

Unicam Instruments Ltd. (107). The Unicam SP.200, which is being exhibited, is said to mark a new stage in bringing infra-red spectroscopy to the chemist. The SP.200 is designed essentially for routine analysis, but several features greatly increase the scope of the instrument. This is particularly important for those users who do not have access to a large infra-red instrument.

The Unicam SP.700 double beam ratio-recording spectrophotometer, shown in a production example of Mark II, is now available with an increased range of scales that gives facilities for scale expansion, the recording of differential spectra and (with the absorbence accessory fitted) the recording of absorbence.

Three scales are provided for differential spectroscopy, where the ratio of the transmittances of two samples is required and the relative transmittance may be greater than 100 per cent. These scales are 90-110 per cent, 0-200 per cent, and −0·3 to +1·7 absorbence.

Industrial News *Home and Overseas*

Rolling Mill Equipment

To design and manufacture a variety of equipment for the handling and processing of coil and strip, **Lapper Equipments Ltd.**, of Wolverhampton Street, Dudley, have a technical staff to deal with designs to customers' requirements, and, for the manufacture of a standard range of machines, an agreement with an associate company, Maley and Taunton Ltd., of Wednesfield.

Lapper Equipments was formed recently on the return to business of Mr. J. Lapper, formerly managing director of Auxiliary Rolling Equipment Ltd., who had to retire from that position for health reasons. The new company is building strip pickling and cleaning lines, coil welding lines, coil cut-up lines, heavy motorized uncoilers, light duty slitting machines, and a variety of coil and strip handling devices to suit existing mill arrangements.

International Tin

An interim committee of the second International Tin Agreement held its first meeting in London early this week to make such arrangements as are necessary to facilitate the entry into force on July 1, this year, of the second agreement. A Press communique issued said representatives from Australia, Belgium, Bolivia, the Congo Republic (Leopoldville), France India, Indonesia, Italy, the Federation of Malaya, the Netherlands, the Federation of Nigeria, Ruanda-Urundi, Spain, Thailand and the United Kingdom attended. Membership of the interim committee is at present open to all governments which are members of the current Agreement, which expires on June 30 this year, or which are signatories to the second Agreement.

It is proposed that, in future, membership should be open to those countries which were unable to sign the second Agreement by December 31 last year, but which have informed the U.K. Government or the chairman of the interim committee of their intention to apply for accession to the second Agreement at the first meeting of the Council established under that Agreement.

It was reported that the second Agreement had been signed on behalf of Australia, Austria, Belgium, Bolivia, Canada, the Congo Republic (Leopoldville), Denmark, France, India, Indonesia, Italy, Japan, Malaya, Mexico, the Netherlands, Nigeria, Ruanda-Urundi, Spain, Thailand, Turkey and the U.K. These signatures more than fulfil the minimum requirements which are laid down in the second Agreement as a necessary step towards the ratification of that Agreement, the communique said.

The committee also set up a number of subcommittees to deal with various aspects of the problems involved in the transition from the first Agreement Council to the Council of the second. The Committee's next meeting is scheduled for March 7 this year, the communique added.

Theft of Metal

It is reported by the **National Association of Non-Ferrous Scrap Metal Merchants** that a 7-ton blue Bedford lorry, Registration No. 2496 ME, containing the following items, was stolen in the Enfield Highway area during the night of January 3 last: copper sheet cuttings in briquettes (loose), weight 4 tons 2 cwt.; 31 bags small copper cuttings, weight 18½ cwt.; 108 ingots zinc alloy, B.S.1004A (four-section ingots), marking — small A PM; 170 ingots aluminium bronze, B.S.1400 AB1, marking—grey paint splash (includes two ingots marked 5502 and two ingots marked 5504 in black on white. Approximate value, £1,500.

Any reader able to give assistance as regards this theft is asked to contact Platt Metals Ltd., Metalex Works, Great Western Road, Enfield, Middx., or to Detective-Sgt. Jaques, Enfield Highway Police Station, Telephone Howard 1113.

A New Club

Inaugurated at the end of last year, the "25 Year Club" of **Keeton Sons and Company Ltd.** is open to all members of the company who have completed 25 years' service with the firm. At the inaugural dinner, the first thirteen members were presented with gold watches. The fourteenth member of the Club, Mr. Albert Whittaker, the managing director, made the presentations. Mr. Whittaker has been with the company since 1920.

Measuring Machines

Recent news from **David Brown Industries Ltd.** (Tool Division) is that they have added to their range of gear measuring equipment by the introduction of the No. 18 series combined involute and helix measuring machines. Designed to accommodate sizes of spurs and helical gears having base circle diameters ranging from $\frac{7}{8}$ in. to 18 in., the series will be made by the tool division at Park Works, Huddersfield.

With the centre locating column in position, the machines will admit gears up to 12 in. diameter with 18 in. between centres. Gears up to 18 in. base circle diameter can be accepted when the centre column is removed.

Imports of Russian Lead

According to trade circles in London, imports of Russian lead into the United Kingdom during last November were believed to amount to about 1,000 tons. This is a considerable increase when compared with the known arrivals of 3,008 tons over the whole of the January to October period of 1960. Output of the USK-Kamenogorsk plant, whose lead brand, YKCUK, has recently been admitted to the London Metal Exchange official list of standard brands, is believed to be around 30,000 tons annually.

Trade with Denmark

A cargo of refractory materials was recently transported from the U.K. to Denmark. The cargo consisted of "Tri-Mor" high temperature castable refractories, manufactured by **Morgan Refractories Ltd.** The consignment, worth some £20,000, is destined for use instead of firebricks in the lining of two large power station boilers in Denmark.

Selling Rights

It is learned from **Keelavite Hydraulics Ltd.** that they have acquired world selling right for a complete range of high pressure hydraulic equipment known as the Keelavite-Gury range. They have also acquired marketing rights for the Hydro-Titan hydraulic axial piston units in the U.K. and the Commonwealth. There are 16 units, which may be used as pumps or motors, depending on mounting and control mechanism.

Precision Surface Grinder

A small, hand-operated surface grinder has just come on the market, which can deal with diameters up to 7½ in. and with rectangular areas of up to 6 in. by 12 in. and 4 in. by 16 in. This machine is being introduced by **H. G. Stevens Company Ltd.**, and it occupies little more bench space than a fly press or bench drill, and it should be most useful in a number of applications.

New Welding Shield

Many welding operations take place on site, and in many cases the site itself offers hazards that would not normally be met in a welding shop. In connection with this, **Safety Products Ltd.** have produced a combination of the "Pulsafe" hard hat and welding shield.

The welding shield is attached to the hard hat by means of a patented, simple, recessed sliding plastic block which is locked in place by means of a spring-loaded catch. It is easy to use, being necessary to just push the spring lip back with the thumb and slide the shield clear.

The hard hat is available in moulded plastic, there being an adjustable head harness and chin strap, which the wearer can arrange to suit his own comfort. In the case of the welding shield, it is available in either moulded vulcanized fibre or fibre glass and is fitted with a "flip-up" front, which allows the operator to chip or weld without raising the shield.

Welding Charts

In a series of Sifbronze welding data and instruction charts, No. 2 has just been published by the **Suffolk Iron Foundry (1920) Ltd.** This quick reference chart gives at a glance conversion factors and tables, temperature scales, flame temperatures, gas values, melting points and welding data for Sifbronze welding on mild steel fusion welding. The chart also illustrates common defects in welding and forms of welding joints.

The chart is printed in two colours and is suitable for mounting on plywood or hardboard, thus making it useful for display in welding shops, instruction schools and technical colleges.

Minerals in Australia

A senior executive of the Kaiser Corporation of the United States has forecast that Australia eventually would be self-sufficient in the production and refining of all types of metals. The executive, Mr. John Probst, said Australia had abundant natural resources of minerals of all kinds and needed only the facilities to exploit them.

Mr. Probst reached Sydney by air to take charge of the Kaiser Aluminum interests in Australia. His appointment follows the announcement of plans by the Kaiser Corporation and Consolidated Zinc to process bauxite from the rich Weipa

fields in North Queensland. Mr. Probst was formerly manager of the Kaiser Aluminum plant at Buffalo, in the United States. The Kaiser Corporation is a large processor of bauxite in the United States, but the opening of a new office in Sydney represents its first venture into the Australian aluminium industry.

Spanish Tin Production

Spanish production of fine tin and tin alloy in the twelve months following the stabilization plan, July 1959 to June 1960, amounted to a monthly average of 47,100 tons, a drop of 34 per cent compared with the monthly average for 1958 and 4,200 less than that for 1956.

Shaker Hearth Furnace Installation

Recent news from **Wild-Barfield Electric Furnaces Ltd.** is that they have received an order from the Birmingham firm of L. H. Newton Ltd., for a continuous shaker hearth furnace installation. The equipment will be charged automatically and work untouched by operators as it is progressed through hardening, quenching, washing, tempering and final quenching for delivery into collecting baskets at the rate of 600 lb/hr. Hand adjustments will be provided to enable certain work to be diverted after quenching and before entering the washing equipment.

Initial charging will be carried out by means of a vibratory feeder, and progress through the hardening and tempering furnaces will be by twin shaker hearth trays. Belt type extractors will be employed to remove work from the quench tanks.

Both furnace chambers will be provided with an endothermic atmosphere and automatic temperature control. Oil in the quench tanks will be violently agitated, and its overheating will be prevented by the use of thermostats, controlling coolers and circulating pumps.

Scrap Exports Banned

A recent Government Order issued in Guatemala revokes all previous orders authorizing the export of non-ferrous metal scrap and forbids the future export of such metal from both private and Government stocks.

Contract Awarded

It has been announced by **Aluminium Wire and Cable Company Ltd.** that they have been awarded a contract by the New Zealand Electricity Department to supply 465 miles 54/7/0·125 in. steel-cored aluminium bare electrical conductor worth approximately £250,000.

This conductor is to be used in the 220 kV main transmission system in the North and South Islands and will join similar conductor supplied by the company over the past few years.

Factory Law

A two-day course of lectures on industrial and factory law, especially designed for industrial managers and executives, and including the latest legislative changes, will be given by Mr. Harry Samuels, O.B.E., M.A., barrister-at-law, at the Industrial Welfare Society's headquarters on February 6 to 8.

Full particulars of this course may be obtained from the society, at 48 Bryanston Square, London, W.1.

Indian Metal Production

According to the Indian Bureau of Mines, India's production of copper ore during January - October, 1960, was 369,072 metric tons. This represents an increase of about 9 per cent, as compared to the output of 338,512 metric tons in the corresponding period of 1959. The production of copper metal during January-October, 1960, was 7,431 metric tons, as compared to 6,592 metric tons in the corresponding period of 1959.

India produced 127,000 tons of lead-zinc ores during January-October, 1960, as compared to 134,000 metric tons, in the corresponding period of the preceding year. Production was concentrated in the Zawar mines in Udaipur district of Rajasthan state.

A Students' Evening

On February 2 next, a Students' Evening and Conversazione is being held at the College of Advanced Technology, Gosta Green, Birmingham, by the **Birmingham Metallurgical Society.** There are to be metallurgical exhibits by Midland firms and competitive exhibits by students.

The competition is open to all students under 25 studying at colleges in Warwickshire, Worcestershire and South Staffordshire, and five classes of entries are open. Work to be exhibited should preferably be of an original nature and must be the student's own work.

There will also be showings of films and metallurgical demonstrations. Full details and entry forms may be obtained from the Secretary of the Society, c/o Brown Bayley Steels Ltd., 21 Bennetts Hill, Birmingham, 2.

Decorative Super Purity Aluminium

Under this title, an interesting 24-page brochure has been issued by **The British Aluminium Company Limited,** drawing attention to some of the applications of super purity aluminium and its alloy for the building industry, car industry, electrical industry, and for many decorative purposes.

Compositions and typical mechanical properties are detailed, and many excellent illustrations are given of the varied applications to which this metal can be put.

Metal Stocks

Stocks of refined tin in London Metal Exchange official warehouses at the end of last week rose 144 tons to 9,710 tons, comprising London 4,285, Liverpool 3,625 and Hull 1,800 tons.

Copper stocks fell 175 tons to 14,159, distributed as follows: London 700, Liverpool 10,684, Birmingham 400, Manchester 2,300 and Hull 75 tons.

Contracts for G.E.C.

Orders for two ore-handling plants, worth a total of £1½ million, have recently been received by **The General Electric Company Limited.** One of these plants, valued at £1 million, is for installation at the Scunthorpe South Works of the Appleby-Frodingham Steel Company Ltd. The other is for the Ravenscraig works of Colvilles Ltd., and this brings the total value of orders received by G.E.C. for the Ravenscraig works during 1960 to £2½ million.

Rolling Mill Contracts

Two Sheffield engineering companies acting together as a consortium, **Davy and United Engineering Company Ltd.** and the **Brightside Foundry and Engineering Company Ltd.,** have secured a contract worth just over £2½ million to build rolling mills required for the new Tinsley Park works of English Steel Corporation Ltd. The Tinsley Park project, estimated to cost £26 million, is stated to be the largest single industrial development so far undertaken within the city of Sheffield.

A Chemicals Catalogue

A new general chemicals catalogue has been issued this month by **Albright and Wilson (Mfg.) Ltd.** An insert section shows the way in which these chemicals are used throughout British industry in the production of a multitude of industrial and consumer products in everyday use. Close on 350 products are listed in the catalogue, which is neatly designed for ready reference in a bold alphabetical form.

Southern Rhodesian Production

Figures recently issued in Salisbury by the Department of Mines show that Southern Rhodesia produced 1,309 tons of copper in November this year, compared with 1,443 tons in October and 1,165 tons in November 1959. Total exports during the first eleven months of this year were 13,975 tons, against 10,842 tons in the corresponding period of last year.

It is also shown that 57 tons of tin metal were produced in November this year compared with 54 tons in October, and 59 tons in November 1959. Production during the first eleven months of this year totalled 624 tons, against 586 tons in the corresponding period of last year.

Staff Training

A staff training centre at Chartridge Lodge, near Chesham, Buckinghamshire, has been opened this month by **The British Oxygen Co. Ltd.** At first, priority will be given to the senior and middle levels of management. As the College develops, however, a wider field is to be covered and it is hoped to start courses for foremen and supervisors by the end of 1962. Course members will be able to brush up the basic knowledge and skills which should ideally be common to all managers; to consider the functions of other departments and the operations of the company as a whole.

Courses, which will all be residential, will vary in length from two to four weeks, and the work of the College will supplement other management development and training plans. The principal of the college is Lieut.-Col. T. O'G. Cochrane, and the bursar, Mr. St. V. E. B. Pollard.

Tin and its Uses

In the latest issue of the journal with the above title, published by the **Tin Research Institute,** space is given to photographs taken during the visit of H.R.H. The Duke of Edinburgh to the headquarters of the Institute at Perivale late last year.

Anti-friction bearings containing 6 per cent of tin, remainder aluminium, are now being made in France from rod which has been continuously cast. It is said that the advantages of this method of casting are, that the structure of the tin-aluminium alloy has excellent anti-friction qualities, combined with high strength, and the material can be used for solid bearings without a steel backing.

Although tinplate containers are used in their thousands of millions, this is only possible thanks to the most careful methods of control of the material, both in its manufacture and usage. Some of the intricacies of the study of these prob-

lems are described in an article entitled "Resistance of Tinplate to Rust and Corrosion".

There is also an article on the value of employing both zinc and tin together as electroplated coatings upon steel exposed to severe weather conditions. Perfection in soldering is a "must" for the electronic industries, and an article in this same journal discusses the merits of various types of pre-treatments of parts which have to be soldered and suggests a combination of electroplating with pure tin, followed by fusion of the coating, which may be the practical answer in many instances.

Expansion Plans

A second stage in the erection of the new factory at Chessington for the **Solartron Laboratory Instruments Ltd.,** the electronic instrument manufacturing company of the Solartron Electronic Group, is now under way. The administrative block of 25,000 ft², which presently houses the instrument sales and the international division of Solartron, was occupied early in 1960. Also in this block are the instruments servicing and works training sections, together with some production facilities.

The second section of 50,000 ft² being built will be completed in October 1961, and the third stage—a further expansion of 50,000 ft², for which the Chessington site has available space—will be completed in three years' time. The final factory will be one of the most modern in Britain for the manufacture of electronic instruments and will employ more than 1,000 people.

The training centre, which is now incorporated in the new buildings, is claimed to be the most advanced for workers in electronics. A special study has been made of training methods and the result is that operators are working confidently at full production at their benches after an initial training period of six weeks. The training continues from time to time in intensified courses for two years for the creation of an expert operator. In fact, training is integrated with production somewhat as is a university "sandwich" course.

Problems of Communication

Rapid communication between science and industry is a vital link in modern technology. And to-day, when over three hundred million pounds are spent each year on industrial research and development, effective communication is a problem facing industrial and research management.

Research results must be made known quickly and clearly to the widest possible technical audience; existing knowledge must be used with benefit; and the time lag between a scientific development and industrial application must be cut.

This will be the theme of a two-day national conference—"Science and Industry: The Problem of Communication"—to be held at the Brangwyn Hall, Swansea on April 18-19. Aimed at industry, especially firms in the rapidly expanding industrial areas of Wales, it will deal extensively with the many problems of disseminating research results. It is being organized by the **Department of Scientific and Industrial Research,** with the assistance of a local advisory committee under the chairmanship of Sir Maynard Jenour.

About 300 delegates from industry and industrial research organizations are expected to attend, and a feature of the programme is the ample time that will be allowed for discussion following each speaker's Paper.

The conference fee is 5 gn., and those interested in attending are advised to apply without delay to the D.S.I.R. Liaison Officer for Wales, Block II, Government Buildings, Gabalfa, Cardiff.

Polish Copper Industry

Czechoslovakia is to grant Poland a loan of 112·5 million roubles for the development of copper mines and copper processing plants under an agreement signed in Prague, the Czechoslovak news agency Ceteka reported. Poland will pay off the loan from 1969 to 1978 by delivering electrolytic copper, semi-finished material and copper products to Czechoslovakia.

Forthcoming Meetings

January 14—Institute of Metal Finishing. London Branch. Café Royal, Regent Street, London, W.1. Annual Dinner and Dance. 6.30 p.m.

January 16—Institute of Metal Finishing. North-West Branch. Ogden Arms Hotel, Sackville Street, Manchester. "Hard Chrome Plating." J. Cofe. 7.30 p.m.

January 16—Institute of Metal Finishing. London Branch. Northampton College of Technology, St. John Street, London, E.C.1. "Chromate Conversion Coatings on Aluminium." W. Marchand. 6.15 p.m.

January 16—Institute of British Foundrymen. East Anglian Section. Lecture Hall, Public Library, Ipswich. "Origin, Detection and Elimination of Gases in Cast Metals." Dr. D. V. Atterton. 7.30 p.m.

January 17—Institute of Metals. South Wales Local Section. Royal Institution, Swansea. "Metals and Alloys Used in the Jewellery and Silverware Industry." Miss D. L. Pile. 7 p.m.

January 17 — Institution of Production Engineers. London Graduate Section. 10 Chesterfield Street, London, W.1. "Modern Welding Techniques." W. H. Holland. 7.15 p.m.

January 18—Society of Chemical Industry. Corrosion Group. 14 Belgrave Square, London, S.W.1. "Metallic Diffusion Coatings." R. L. Samuel 6 p.m.

January 18—Institute of Metal Finishing South-West Branch. Assize Courts Hotel, Bristol. "Methods of Preparation for Plating: (c) Chemical and Electrochemical." D. Sinclair. 7.30 p.m.

January 19—Institute of Metals. Birmingham Local Section. College of Technology, Gosta Green, Birmingham. "The Heat-Treatment of Engineering Components." E. Mitchell. 6.30 p.m.

January 19—Institute of Metals. Sheffield Local Section. Applied Science Buildings, Sheffield University, St. George's Square, Sheffield. "Ductile Fracture." Prof. R. W. K. Honeycombe. 7.30 p.m.

January 19 — North-East Metallurgical Society. Cleveland Scientific and Technical Institution, Corporation Road, Middlesbrough. "The Effects of Nuclear Radiation on Metals." Dr. H. M. Finniston. 7.30 p.m.

January 19 — Institution of Plant Engineers. Blackburn Branch. Castle Hotel, Blackburn. "Industrial Heating and Ventilating." S. P. Fildes. 7.30 p.m.

Men and Metals

News from The British Aluminium Company Limited is that **Sir William Strath** has been appointed to the board with effect from February 1 next, and has also been appointed managing director from the same date. It is understood that **Lord Plowden** will remain as chairman of the company. **Mr. J. Ritchie** will be leaving the company at the end of this present month in order to take up another appointment, and will thus relinquish his position as financial director and his other directorships within the B.A. group.

A number of appointments have been announced by Glynwed Tubes Limited in connection with its subsidiaries. **Mr. F. H. A. Mackrill** has retired as managing director of the main company but stays on the board. The following have been appointed to the boards of the subsidiary companies: **Mr. D. E. Drake** and **Mr. P. J. Custis** (Wednesbury Tube Company), **Mr. E. J. Skinner** (Glynwed Plant and Socketex), **Mr. M. Coyne** (Hipkiss Bros.), **Mr. J. H. Slater** (Steelway), **Mr. F. Skinner** (Yarwood Ingram and Company), **Mr. H. E. Amey** and **Mr. K. J. Gray** (Socketex).

After 32 years' service in the Royal Air Force, **Air Vice-Marshal W. E. Oulton,** C.B., C.B.E., D.S.O., D.F.C., has retired from the Service and has joined the board of E.M.I. Electronics Limited as director responsible for Ministry work.

Sectional directors have recently been appointed by Crofts (Engineers) Limited as follows: **Mr. H. Goldthorpe** as works director; **Mr. C. Mason** as branch works director; **Mr. A. Hearn** as production control director; and **Mr. S. W. Ball** as foundry control director.

Following his retirement as chairman of the Kestner Evaporator and Engineering Company and the Kestner group of companies, **Mr. J. Arthur Reavell** has assumed the appointment as the company's first President. His son, **Mr. Brian N. Reavell,** has been appointed chairman.

Appointments within the Delta Metal Group have been announced as follows: **Mr. K. E. West** to be managing director of Earle, Bourne and Company Limited, **Mr. J. R. Roby** having resigned from this position. **Mr. W. S. Davis** is to be appointed secretary of Earle, Bourne and Company Limited and Alfred Case and Company Limited, in place of **Mr. F. J. Bindon-Blood,** who has retired.

Leaving England this week, **Mr. R. P. S. Bache,** chairman and managing director of Geo. Salter and Company Limited, is to make two overseas sales tours during the next few months. His first visit will be to India, calling at Bombay, Delhi and Calcutta. He will then visit Australia, New Zealand, South Africa, and Rhodesia.

Metal Market News

THE Metal Exchange had another short week, for the metal market was closed on January 2, since New Year's Day fell on a Sunday this year. On Monday, however, important news came through about the Braden strike position, for it was announced that the question whether or not El Teniente should cease production had been postponed for seven days. On the following day, Tuesday, when trading in copper began again, both cash and three months lost ground, partly on the news from Chile, but also due to an increase, albeit a modest one, in L.M.E. stocks of 240 tons to 14,334 tons. Other stock figures provided were 9,566 tons of tin, up by 159 tons, and also lead and zinc, under the new contractual arrangement, the former being 6,926 tons, and the latter only 1,919 tons. For better or for worse, zinc and lead are now launched as metals dealt in on an "in warehouse" basis, with daily settlement prices, as for tin and copper. Stocks, too, will be reported weekly, so that the four metals are now in line with each other in the matter of presentation of prices and statistics. The London Stock Exchange made a rather better showing last week, and on Wednesday Wall Street staged a really big rally. To some extent, this helped sentiment in Whittington Avenue, and the following day saw a rather firmer tone. With the exception of copper all the metals registered some improvement, tin and lead making their best showing for some weeks past.

Before trading in copper came to an end last Friday afternoon, it was generally assumed that the strike at El Teniente would take place, inasmuch as the gap between the owners' ideas on what constitutes a fair and reasonable wage increase differed so widely from that of the workers. As we write, definite news is lacking, but in spite of attempts at a settlement by the Chilean government, it seems virtually certain that a stoppage will take place. As to the duration of such a strike, it can only be said that the Chuquicamata stoppage went on for nearly six weeks, and the trouble at El Teniente might last just as long. In spite of the prospect of a reduction in the amount of copper available, the standard market last week lost ground, mainly on account of the lack of physical business with consumers. About 9,500 tons changed hands, cash being marked down by £3 10s. 0d., and three months by 30s. The backwardation of £1 10s. 0d. disappeared and was replaced by a contango of from 10s. to 15s.

The reappearance of a contango is welcome, but with the prospect of yet another strike in the offing, the existence of a premium for the forward position may well prove to be a "false dawn". It is certain that consumers and others who use the London market for hedging their length in copper, will act with the utmost caution, for they have suffered many disappointments and losses through the development of a backwardation. In tin, 835 tons changed hands, cash closing 10s. up at £789, and forward £1 up at £790. The transition in lead and zinc to the new contracts passed off smoothly, and both metals improved in value. On a turnover of 4,760 tons, lead was up £1 12s. 6d. for cash, at £64 2s. 6d., and 17s. 6d. better for three months, at £65 5s. 0d. Some 6,400 tons of zinc changed hands, cash advancing £3 5s. 0d. to £81 15s. 0d., and three months 2s. 6d. to £79 10s. 0d.

Birmingham

Quiet conditions prevail in Midland industry, and there has been little change in the position since the year opened. Brassfounders are moderately well occupied on home and export trade. Demand from the building industry for a variety of fittings has been a feature during the last few months. There is also a fair amount of business in metal fittings required in equipment of new office blocks and business premises in local towns. The outlook in regard to the motor trade has not changed. Requirements for factories working a four day week—and in some case only three—are easily met, and there is no indication of an early improvement in demand.

Demand for iron and steel is fairly high from industries not associated with motor vehicle production. Stocks in consumers' hands have risen steadily in the last few months, and except for heavy building steel and some special tool steels, which are still the subject of some delay, raw materials can be obtained fairly promptly. The re-rolling mills are well situated for supplies of semi-finished steel and are able to supply the steady demand for small bars and sections. Iron foundries are less active, although demand for heavy engineering castings is maintained.

New York

Week-end reports are that copper futures, after an early slight decline, steadied on covering influenced by the threat of a strike at El Teniente. Dealings were light, most operators being content to wait for weekend developments at El Teniente. Traders said that physical copper was quiet in the domestic sector, and there was moderate interest in the export field at 27½ to 27¾ cents/lb. In domestic trading, reports indicated that at least one custom smelter was offering as a dealer at the dealer price level of around 29 cents/lb., but this could not be confirmed. The custom smelter and producer price continued at 30 cents.

Tin was quiet and steady. Lead and zinc were quiet. In the closing stages, tin was quiet and softer. Copper for export was steadier; domestic prices were unchanged. Scrap copper was quiet but steady.

The market situation in zinc continues confused. There is still no hard spot price for Prime Western zinc. Since St. Joseph Lead Company, a few days ago, offered price concessions to all its customers of $10 per ton below the E.M.J. average price basis, leading sellers have been selling at an average price basis, but not knowing what that average price basis was or would be.

Australia

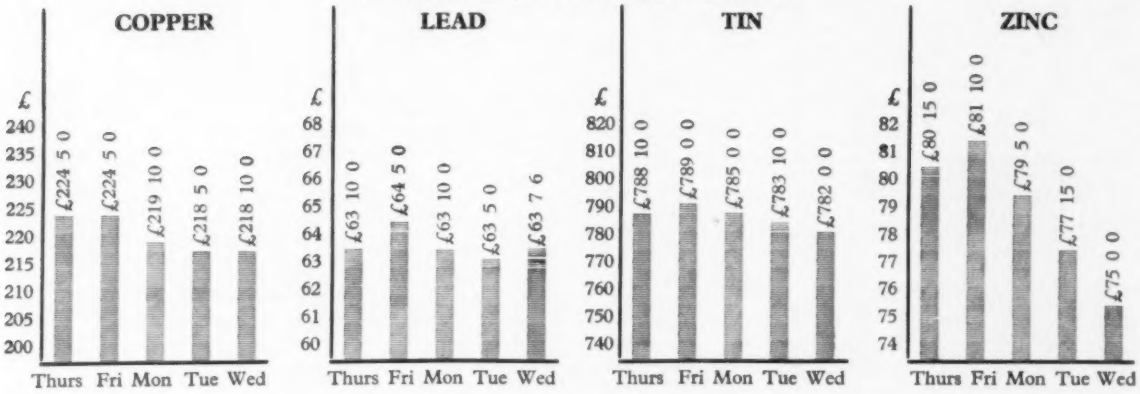
Latest reports from Australia state that the Australian Minister for Trade has referred to the Tariff Board for inquiry and report the question (1) What tariff assistance should be accorded the production in Australia of aluminium, including aluminium alloys whose chief part by weight consists of aluminium, in the form of ingots, pigs, blocks, bars, billets or cast rods? This reference has been made pursuant to the Government's obligation under the terms of sale of the Australian Aluminium Production Commission plant at Bell Bay, Tasmania, to provide protection to the Australian aluminium industry during the four years commencing January 3, 1961, and to ensure to the industry (for the whole of the Australian sales of its output) selling prices equal to the selling price of the Australian Aluminium Production Commission for each particular class or kind of product within the above general description as at November 1, 1960:

(2) Whether assistance should be accorded to the production in Australia of aluminium and alloys in chief part by weight of aluminium, viz: unwrought aluminium and alloys; not further manufactured than plated, polished or decorated, viz: wrought bars, rods, angles, shapes, sections, plates, sheet and strip; wire of solid section; tubes and pipes and blanks therefor; hollow bars; powders and flakes; stranded wire cables, cordage, ropes, plaited bands and the like; scrap and waste; but not including the following, viz: goods covered by the reference at (1) above on aluminium and aluminium alloys ingots, pigs, blocks, bars, billets and cast rods; foil, of a thickness (excluding any packing) not exceeding 0·15 millimetre; insulated electric wire, cable, bars, strip and the like. This reference is of Departmental origin and is complementary to the reference at (1) above.

Non-Ferrous Metal Prices

London Metal Exchange

Thursday 5 January to Wednesday 11 January 1961



Primary Metals

All prices quoted are those available at 2 p.m. 11/1/61

		£	s.	d.
Aluminium Ingots	ton	186	0	0
Antimony 99·6%	„	217	10	0
Antimony Metal 99%	„	210	0	0
Antimony Oxide Commercial	„	194	10	0
Antimony White Oxide	„	196	0	0
Arsenic	„	400	0	0
Bismuth 99·95%	lb.		16	0
Cadmium 99·9%	„		11	0
Calcium	„	2	0	0
Cerium 99%	„	15	0	0
Chromium	„		6	11
Cobalt	„		12	0
Columbite	per unit		—	
Copper H.C. Electro	ton	218	10	0
Fire Refined 99·70%	„	217	0	0
Fire Refined 99·50%	„	216	0	0

		£	s.	d.
Copper Sulphate	ton	76	10	0
Germanium	grm.		—	
Gold	oz.	12	14	5
Indium	„		10	0
Iridium	„	24	0	0
Lanthanum	grm.		15	0
Lead English	ton	63	17	6
Magnesium Ingots	lb.			
99·8%	„		2	2½
99·9+%	„		2	3
Notched Bar	„		2	9½
Powder Grade 4	„		6	1
Alloy Ingot, AZ91X	„	1	11½-2	1½
Manganese Metal	ton		—	
Mercury	flask	69	0	0
Molybdenum	lb.	1	10	0
Nickel	ton	600	0	0
F. Shot	lb.		5	5
F. Ingot	„		5	6
Osmium	oz.		nom.	
Osmiridium	„		nom.	

		£	s.	d.
Palladium	oz.	9	0	0
Platinum	„	30	5	0
Rhodium	„	46	0	0
Ruthenium	„	16	0	0
Selenium	lb.		nom.	
Silicon 98%	ton		nom.	
Silver Spot Bars	oz.		6	7½
Tellurium Sticks	lb.	2	0	0
Tin	ton	782	0	0
***Zinc**				
Electrolytic	ton		—	
Min 99·99%	„		—	
Virgin Min 98%	„	77	8	1½
Dust 95/97%	„	128	0	0
Dust 98/99%	„	134	0	0
Granulated 99+%	„	102	8	1½
Granulated 99·99+%	„	117	18	9

****Duty and Carriage to customers' works for buyers' account.***

Foreign Quotations

Latest available quotations for non-ferrous metals with approximate sterling equivalents based on current exchange rates

	Belgium fr/kg≏£/ton	**Canada** c/lb≏£/ton	**France** fr/kg≏£/ton	**Italy** lire/kg≏£/ton	**Switzerland** fr/kg≏£/ton	**United States** c/lb≏£/ton
Aluminium		26.00 215 16	2.43 179 11	370 216 1	2.50 206 5	26.00 207 4
Antimony 99.0			2.30 170 0	495 286 3		29.00 231 2
Cadmium			15.75 1,069 0			150.00 1,195 10
Copper						
Crude						
Wire bars 99.9				430 251 2		
Electrolytic	31.25 228 0	28.50 236 11	3.13 231 6		2.80 231 0	30.00 239 2
Lead		10.00 81 0	.94 69 9	163 95 3	.83 68 9	11.00 87 13
Magnesium						
Nickel		70.00 581 0	9.00 665 2	1,200 699 6	7.50 618 15	74.00 589 15
Tin	108.75 793 0		11.10 820 5	1,480 864 6	9.68 798 12	100.62 801 18
Zinc						
Prime western		12.00 99 12 0				
High grade 99.95		12.60 104 11 0				
High grade 99.99		13.00 107 18 0			1.18 97 7	
Thermic			1.20 88 13			
Electrolytic			1.28 94 13	182 108 7		13.50 107 11

Non-Ferrous Metal Prices (continued)

Ingot Metals

All prices quoted are those available at 2 p.m. 11/1/61

		£	s.	d.
Aluminium Alloy (Virgin)				
B.S. 1490 L.M.5	ton	210	0	0
B.S. 1490 L.M.6	„	202	0	0
B.S. 1490 L.M.7	„	216	0	0
B.S. 1490 L.M.8	„	203	0	0
B.S. 1490 L.M.9	„	203	0	0
B.S. 1490 L.M.10	„	221	0	0
B.S. 1490 L.M.11	„	215	0	0
B.S. 1490 L.M.12	„	223	0	0
B.S. 1490 L.M.13	„	216	0	0
B.S. 1490 L.M.14	„	224	0	0
B.S. 1490 L.M.15	„	210	0	0
B.S. 1490 L.M.16	„	206	0	0
B.S. 1490 L.M.18	„	203	0	0
B.S. 1490 L.M.22	„	210	0	0
Aluminium Alloys (Secondary)				
B.S. 1490 L.M.1	ton	180	0	0
B.S. 1490 L.M.2	„	183	0	0
B.S. 1490 L.M.4	„	193	0	0
B.S. 1490 L.M.6	„	192	0	0
***Aluminium Bronze**				
BSS 1400 AB.1	ton	238	0	0
BSS 1400 AB.2	„	246	0	0

		£	s.	d.
***Brass**				
BSS 1400-B3 65/35	ton	170	0	0
BSS 249	„		—	
BSS 1400-B6 85/15	„	218	0	0
***Gunmetal**				
R.C.H. 3/4% ton	„		—	
(85/5/5/5) LG2	„	210	0	0
(86/7/5/2) LG3	„	220	0	0
(88/10/2/1)	„	273	0	0
(88/10/2/½)	„	284	0	0
***Manganese Bronze**				
BSS 1400 HTB1	„	191	0	0
BSS 1400 HTB2	„	207	0	0
BSS 1400 HTB3	„	227	0	0
Nickel Silver				
Casting Quality 12%	„	242	0	0
„ „ 16%	„	263	0	0
„ „ 18%	„	293	0	0
***Phosphor Bronze**				
B.S. 1400 P.B.1. (A.I.D. released)	„	299	0	0
B.S. 1400 L.P.B.1	„	233	0	0

**Average prices for the last week-end.*

		£	s.	d.
Phosphor Copper				
10%	ton	254	0	0
15%	„	257	0	0
Phosphor Tin				
5%	„		—	
Silicon Bronze				
BSS 1400-SB1	„	274	0	0
Solder, soft, BSS 219				
Grade C Tinmans	„	360	10	0
Grade D Plumbers	„	288	10	0
Grade M	„	396	10	0
Solder, Brazing, BSS 1845				
Type 8 (Granulated)	lb.		—	
Type 9 „	„		—	
Zinc Alloys				
BSS 1004 Alloy A	ton	111	8	9
BSS 1004 Alloy B	„	115	8	9
Sodium-Zinc	lb.		2	6½

Semi-Fabricated Products

Prices vary according to dimensions and quantities. The following are the basis prices for certain specific products.

		£	s.	d.
Aluminium				
Sheet 10 S.W.G.	lb.		2	10
Sheet 18 S.W.G.	„		3	0
Sheet 24 S.W.G.	„		3	3
Strip 10 S.W.G.	„		2	10
Strip 18 S.W.G.	„		2	11
Strip 24 S.W.G.	„		3	0½
Circles 22 S.W.G.	„		3	4
Circles 18 S.W.G.	„		3	3
Circles 12 S.W.G.	„		3	2
Plate as rolled	„		2	9½
Sections	„		3	3½
Wire 10 S.W.G.	„		3	1
Tubes 1 in. o.d. 16 S.W.G.	„		4	3
Aluminium Alloys				
BS1470. HS10W.				
Sheet 10 S.W.G.	„		3	2½
Sheet 18 S.W.G.	„		3	5
Sheet 24 S.W.G.	„		4	0½
Strip 10 S.W.G.	„		3	2½
Strip 18 S.W.G.	„		3	4
Strip 24 S.W.G.	„		4	0
BS1477. HP30M.				
Plate as rolled	„		3	0½
BS1470. HC15WP.				
Sheet 10 S.W.G.	„		4	2
Sheet 18 S.W.G.	„		4	7
Sheet 24 S.W.G.	„		5	6½
Strip 10 S.W.G.	„		4	3
Strip 18 S.W.G.	„		4	7
Strip 24 S.W.G.	„		5	3
BS1477. HPC15WP.				
Plate heat treated	„		3	8½
BS1475. HG10W.				
Wire 10 S.W.G.	„		4	0½
BS1471. HT10WP.				
Tubes 1 in. o.d. 16 S.W.G.	„		5	3½
BS1476. HE10WP.				
Sections	„		3	3½
Brass				
Tubes	„		1	9½
Brazed Tubes	„		3	0½
Drawn Strip Sections	„		3	0½
Sheet	ton	190	5	0
Strip	„	190	5	0
Extruded Bar	lb.		1	11½
Extruded Bar (Pure Metal Basis)			—	

		£	s.	d.
Brass				
Condenser Plate (Yellow Metal)	ton	183	0	0
Condenser Plate (Naval Brass)	„	195	0	0
Wire	lb.		2	7½
Beryllium Copper				
Strip	„	1	4	11
Rod	„	1	1	6
Wire	„	1	4	9
Copper				
Tubes	lb.		2	1⅝
Sheet	ton	250	15	0
Strip	„	250	15	0
Plain Plates	„		—	
Locomotive Rods	„		—	
H.C. Wire	„	274	5	0
Cupro Nickel				
Tubes 70/30	lb.		3	5⅞

		£	s.	d.
Lead				
Pipes (London)	ton	104	0	0
Sheet (London)	„	101	15	0
Tellurium Lead	„	£6 extra		
Nickel Silver				
Sheet and Strip 10%	lb.		3	10½
Wire 10%	„		4	3¼
Phosphor Bronze				
Wire	„		3	11⅞
Titanium (1,000 lb. lots)				
Billet 4½″ to 18″ dia.	lb.	47/-		48/-
Rod ½″ to 4″ dia.	„	85/-		55/-
Wire ·036″-232″ dia.	„	159/-		99/-
Strip ·001″ to ·048″	„	350/-		68/-
Sheet 8′×2′. 20 gauge	„	73/-		
Tube, representative average gauge	„	198/-		
Extrusions	„	90/-		
Zinc				
Sheet	ton	114	10	0
Strip	„	nom.		

Domestic and Foreign

Merchants' average buying prices delivered, per ton, 10/1/61.

	£
Aluminium	
New Cuttings	139
Old Rolled	105
Segregated Turnings	74
Brass	
Cuttings	156
Rod Ends	142
Heavy Yellow	128
Light	123
Rolled	143
Collected Scrap	126
Turnings	135
Copper	
Wire	199
Firebox, cut up	195
Heavy	192
Light	185
Cuttings	202
Turnings	180
Braziery	165
Gunmetal	
Gear Wheels	190
Admiralty	190
Commercial	177
Turnings	172
Lead	
Scrap	56
Nickel	
Cuttings	—
Anodes	555
Phosphor Bronze	
Scrap	177
Turnings	172
Zinc	
Remelted	73
Cuttings	60
Old Zinc	38

Financial News

LIGHT METALS STATISTICS IN JAPAN (August, 1960)

Classification	Production	Shipment	Stock	Export
Alumina	33,863	36,817	21,465	13,682
Super purity Al	191	106	272	0
Primary Al	11,626	10,395	5,560	0
Secondary Al	3,970	3,996	467	0
Wrought products (Al and its alloy)	10,332	10,369	3,774	1,026
Plate, sheet and strip	7,089	7,288	2,649	691
Foil	738	690	332	78
Rolled and extruded shape	1,356	1,369	281	7
Forgings	37	—	—	—
Electric wire	1,112	1,022	512	250
Powder, flake and paste	—	—	—	—
Casting	5,246	—	—	—
Sand and permanent mould	2,893	—	—	—
Die	2,353	—	—	—
Sheet products	2,035	1,961	1,952	82
Primary Mg	146	171	49	—
Secondary Mg	261	239	302	—
Mg casting	24	—	—	—
Sponge Ti	196	194	1,113	159
Super purity Al (Sept.)	192	52	412	0
Primary Al (Sept.)	11,543	10,885	6,218	0

New Companies

The particulars of companies recently registered are quoted from the daily register compiled by Jordan and Sons Limited, Company Registration Agents, Chancery Lane, W.C.2.

Tewkesbury Plating Co. Limited (677515), Northway Lane, Newtown, Tewkesbury. Registered December 12, 1960. Nominal capital, £3,000 in £1 shares. Directors: Leslie R. Griffiths and Mrs. Marjorie J. Griffiths.

C.M.R. Findings Limited (677587), 15 Mottingham Road, S.W.17. Registered December 12, 1960. To carry on business of art metal workers; manufacturers of and dealers in silver, gold and nickel-plated goods, etc. Nominal capital, £2,000 in £1 shares. Directors: Michael R. Turner, Mary C. Turner and Samuel Conway.

East Anglian Wire Working and Engineering Company Limited (677604), 125 Fore Street, Ipswich. Registered December 13, 1960. Nominal capital, £1,000 in £1 shares. Directors: Claude H. Jackson and Eva M. Jackson.

Metal Developments (1960) Limited (677834), 4-7 Chiswell Street, E.C.1. Registered December 14, 1960. To take over the goodwill and certain other assets of Metal Developments Ltd., Staffordshire Steel Construction Co. Ltd., and Bilson Rust Proofing and Plating Co. Ltd., etc. Nominal capital, £25,000 in £1 shares. Directors: Rt. Hon. Sir Walter J. Womersley, Bt., Joseph W. C. Robinson, George Gamble, Basil H. J. Daniel and John W. Kinsman.

Poulton and Son (Refractories) Limited (678361), Reliance Works, Derry Street, Wolverhampton. Registered December 20, 1960. Nominal capital, £10,000 in £1 shares. Directors: Cyril W. Kieft and Megan Kieft.

G. D. McDougall and Co. (Metal Merchants) Limited (678623), 48a Upper Zoar Street, Wolverhampton. Registered December 22, 1960. Nominal capital, £10,000 in £1 shares. Directors: George D. McDougall and Peter E. Hall.

K. and F. Treatments Limited (678690), Junction Mills, Whingate, Leeds. Registered December 22, 1960. To undertake and experiment with and to act as consultants and patentees in relation to any process in connection with the surface treatment of metals, etc. Nominal capital, £3,000 in £1 shares. Directors: Wm. N. Kitson, Leonard W. Fincham, Jean E. Kitson and Mary Fincham.

Nutfield Metal Works Ltd. (678911), Balfour House, Finsbury Pavement, E.C.2. Registered December 28, 1960. To carry on business of panel beaters, metal workers, etc. Nominal capital, £6,000 in 4,500 ordinary and 1,500 cum. pref. shares of £1 each. Directors: Roy A. J. Jones, Richard J. Baker and Arthur E. Gillson.

Scrap Metal Prices

The figures in brackets give the English equivalents in £1 per ton:—

France (new francs per kilo):

Electrolytic copper scrap	(£216.10.0)	2.93
Heavy copper	(£216.10.0)	2.93
No. 1 copper wire	(£204.14.0)	2.77
Brass rod ends	(£160.7.0)	2.17
Zinc castings	(£64.5.0)	0.87
Lead	(£62.16.0)	0.85
Aluminium	(£136.14.0)	1.85

Italy (lire per kilo):

Aluminium soft sheet clippings (new)	(£181.0.0)	310
Lead, soft, first quality	(£79.8.0)	136
Lead, battery plates	(£44.7.0)	76
Copper, first grade	(£212.15.0)	365
Bronze, commercial gunmetal	(£169.1.0)	290
Brass, heavy	(£142.16.0)	245
Brass, light	(£128.5.0)	220
Brass, bar turnings	(£145.15.0)	250
Old zinc	(£56.12.0)	97

Japan (Yen per metric ton):

Electrolytic copper	(£—)	290,000
Copper wire No. 1	(£—)	272,000
Copper wire No. 2	(£—)	256,000
Heavy copper	(£—)	265,000
Light copper	(£—)	215,000
Brass, new cuttings	(£—)	195,000
Red brass scrap	(£—)	223,000

West Germany (D-marks per 100 kilos):

Used copper wire	(£203.14.0)	235
Heavy copper	(£199.8.0)	230
Light copper	(£173.8.0)	200
Heavy brass	(£125.14.0)	145
Light brass	(£86.14.0)	105
Soft lead scrap	(£52.0.0)	60
Zinc scrap	(£48.11.0)	56
Used aluminium unsorted	(£78.1.0)	90

Trade Publications

Industrial Ovens.—G. and R. Gilbert (Industrial) Limited, Hackbridge Road, Hackbridge, Wallington, Surrey.

A series of revised literature has recently been issued by this company dealing with their range of "Fyna" industrial ovens. These include gas fired box ovens, electric box ovens, also ovens for all types of conveyor and convection heating, and radiant electric and gas fired ovens. Many illustrations are included in the descriptive leaflets, together with technical data, etc.

Confidence in Plating.—The Mond Nickel Company Limited, Thames House, Millbank, London, S.W.1.

The above is the title of a 16-page booklet drawing attention to the Mond labelling scheme for chromium plating. The purpose of the campaign is described and illustrated, and the scheme is operated in collaboration with the British Standards Institution and the British Non-Ferrous Metals Research Association. Copies of the booklet may be obtained on application to the company.

Applications of Lead.—Lead Development Association, 18 Adam Street, London, W.C.2.

This is the latest publication of the association in this series. It deals with lead pigments for primer paints for iron and steel, and is designed to be of general interest to those wishing to expand their knowledge of the material. Copies are available free of charge from the association.

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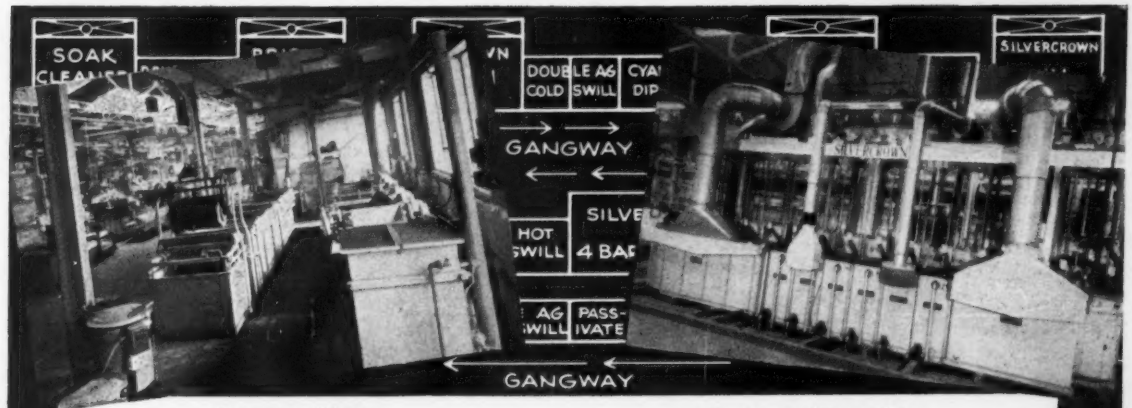
Prices Moving Rather Uncertainly But Moderate Demand In Evidence

ISSUED CAPITAL •	AMOUNT OF SHARE	NAME OF COMPANY	MIDDLE PRICE 10 JANUARY	+RISE—FALL	DIV. FOR LAST FIN. YEAR	DIV. FOR PREV. YEAR	DIV. YIELD	1960 HIGH	1960 LOW	1959 HIGH	1959 LOW
£	£				Per cent	Per cent					
4,435,792	1	Amalgamated Metal Corporation ...	26/9		11	9	8 4 6	34/9	26/9	33/3	23/3
400,000	2/–	Anti-Attrition Metal	1/3		NIL	4	NIL	1/6	0/9	1/7½	1/–
41,303,829	Stk. (£1)	Associated Electrical Industries ...	43/–	+3/–	15	15	6 19 6	67/3	39/3	67/–	54/–
3,236,424	1	Birfield	55/–	+1/–	15‡	15	2 14 6	61/–	34/0	75/4½	46/–
4,795,000	1	Birmid Industries	72/–	+3d.	20	20D	5 11 0	72/9	56/–	75/6	46/9
5,630,344	Stk. (10/–)	Birmingham Small Arms	40/3	+3/6	17½QT	12½	3 14 6	45/6	27/7½	69/–	36/–
203,150	Stk. (£1)	Ditto Cum. A. Pref. 5%	14/10½		5	5	6 12 3	17/4½	14/10½	17/6	15/–
350,580	Stk. (£1)	Ditto Cum. B. Pref. 6%	17/4½		6	6	6 17 3	20/–	17/1½	20/1½	17/9
500,000	1	Bolton (Thos.) & Sons	38/–		10	10	5 5 3	42/3	37/–	47/–	27/6
300,000	1	Ditto Pref. 5%	14/3		5	5	7 0 3	16/–	13/6	16/–	14/9
1,500,000	Stk. (£1)	British Aluminium Co. Pref. 6% ...	18/3		6	6	6 11 6	21/1½	17/9	21/6	18/9
18,846,647	Stk. (£1)	British Insulated Callender's Cables	53/6	+3/–	13½	13½	5 1 0	61/–	47/6	61/–	45/1½
17,047,166	5/–	British Oxygen Co. Ltd., Ord. ...	26/3	+3d.	10	10	1 18 0	34/6	19/6	87/9	49/3
1,200,000	Stk. (5/–)	Canning (W.) & Co.	14/3		15+3½C	25+ *2½C‡	5 5 3	19/6	13/3	18/1½	12/3
60,484	1/–	Carr (Chas.)	1/–		NIL	12½	—	2/3	1/–	2/10½	1/3
555,000	1	Clifford (Chas.) Ltd.	28/–		10	10	7 2 9	35/–	28/–	30/–	22/6
45,000	1	Ditto Cum. Pref. 6%	16/–		6	6	7 10 0	16/–	15/9	16/–	17/–
300,000	2/–	Coley Metals	3/6	—3d.	15	15	8 11 6	5/–	3/3	4/6	2/6
10,185,696	1	Cons. Zinc Corp.†	67/6	+3/6	20	15	5 18 6	80/–	60/6	77/3	57/9
5,399,056	1	Davy-Ashmore	132/6	+3/6	30‡	20	2 5 6	146/3	100/6	116/–	43/–
7,695,000	5/–	Delta Metal	20/6	+7½d.	17½	31‡	4 5 3	28/–	18/7½	26/4½	11/6
5,296,550	Stk. (£1)	Enfield Rolling Mills Ltd.	47/–	+1/–	15	15	6 7 9	56/3	45/–	61/9	36/7½
1,155,000	1	Evered & Co.	43/6	+9d.	10B	10♣	3 1 3	42/9	29/–	42/6	30/–
18,000,000	Stk. (£1)	General Electric Co.	31/3	+1/6	10	10	6 9 0	47/6	29/3	50/6	30/–
1,500,000	Stk. (10/–)	General Refractories Ltd.	44/9	+1/9	20	20	4 9 6	51/6	40/–	47/–	31/4½
750,000	5/–	Glacier Metal Co. Ltd.	15/–		13	11½	4 6 9	15/9	11/1½	11/3	6/7½
2,500,000	5/–	Glynwed Tubes	24/6	—6d.	25¶	20	3 14 0	27/1½	17/7½	30/9	16/1½
7,228,065	10/–	Goodlass Wall & Lead Industries ...	35/6	+9d.	19L	16	3 11 6	41/6	33/4½	53/–	28/7½
696,780	1	Greenwood & Batley	25/–xcap		30W	30	6 0 0	133/9	112/6	130/–	75/–
792,000	5/–	Harrison (B'ham) Ord.	12/9	+9d.	*20‡	*17½	3 18 6	15/4½	11/9	26/9	14/–
150,000	1	Ditto Cum. Pref. 7%	19/7½xd		7	7	7 2 6	20/–	19/3	19/6	19/4½
1,075,167	5/–	Heenan Group	10/9	+3d.	13D	15	5 4 9P	12/6	10/–	19/6	7/4½
249,932,548	Stk. (£1)	Imperial Chemical Industries ...	64/6	+9d.	11½N	8	3 9 9	75/3	54/–	62/7½	33/1½
34,736,773	Stk. (£1)	Ditto Cum. Pref. 5%	15/10½		5	5	6 8 0	17/9	15/6	19/1½	15/6
22,184,044	••	International Nickel	104		$1.60	$1.50	2 16 0	103	85½	201½	154½
300,000	1	Johnson, Matthey & Co. Cum. Pref. 5%	14/–	—9d.	5	5	7 2 9	16/6	14/6	17/6	14/9
6,000,000	1	Ditto Ord.	59/6	+1/9	12D	12	2 13 9	66/6	45/–	50/3	27/3
600,000	10/–	Keith, Blackman	18/9	+1/–	17½	17½E	9 6 6	32/6	17/9	32/–	25/–
320,000	4/–	London Aluminium	8/6	—4½d.	12	10	5 12 0	12/6	7/6	10/7½	5/3
765,012	1	McKechnie Bros. Ord.	57/–		17½F	15F	6 2 9	71/6	57/–	62/6	39/9
1,530,024	1	Ditto A. Ord.	54/–	—1/–	17½F	15F	6 9 0	69/3	55/–	65/6	38/9
1,108,268	5/–	Manganese Bronze & Brass	14/6	+9d.	20⅝	20⅝	7 3 6	18/9	13/4½	19/–	13/6
50,628	6/–	Ditto (7½% N.C. Pref.)	6/–		7½	7½	7 10 0	6/6	6/–	7/9	5/9
21,745,110	Stk. (£1)	Metal Box	68/3xd		12M	13B	3 3 3	83/–	55/9	80/–	44/7½
415,760	Stk. (2/–)	Metal Traders	7/6		50	50	13 6 9	10/4½	7/6	13/6	8/4½
160,000	1	Mint (The) Birmingham	37/–		10	10	5 8 0	39/–	33/6	35/–	22/–
80,000	5	Ditto Pref. 6%	76/3		6	6	7 17 6	80/–	75/–	80/–	69/–
5,187,938	Stk. (£1)	Morgan Crucible A.	54/–	—6d.	13	12	4 16 3	62/3	47/6	52/6	30/–
1,000,000	Stk. (£1)	Ditto 5½% Cum. 1st Pref. ...	16/9		5½	5½	6 13 3	18/6	15/9	19/3	17/3
3,850,000	Stk. (£1)	Murex	42/9	+1/9	22½J	15	6 0 3	45/–	35/3	76/4½	41/–
385,000	5/–	Ratcliffs (Great Bridge) Ord. ...	16/6		10	10R	3 1 6	17/–	14/9	—	
195,000	5/–	Ditto 8% Max. Ord.	5/–		8	—	8 0 0	5/3	5/–	—	
1,064,880	10/–	Sanderson Kayser	33/6	—1/–	35‡	25	5 4 6	40/3	27/7½	56/–	27/9
3,400,500	Stk. (5/–)	Serck	15/9		12½	17½GD	3 19 3	25/–	15/7½	26/–	12/–
7,232,069	Stk. (£1)	Stone-Platt Industries	55/9	+9d.	15	15	5 8 6	64/3	52/3	63/6	42/6
2,928,963	Stk. (£1)	Ditto 5½% Cum. Pref.	15/6		5½	5½	6 17 6	18/7½	15/3	18/9	15/10½
33,989,712	Stk. (£1)	Tube Investments Ord.	77/–	+3/–	14	20	3 12 9	95/9	66/3	138/–	71/7½
41,000,000	Stk. (£1)	Vickers	29/3	+6d.	10	10	6 16 9	39/–	27/3	40/6	26/10½
750,000	Stk. (£1)	Ditto Pref. 5%	14/–		5	5	7 2 9	17/6	14/–	17/3	14/3
6,863,807	Stk. (£1)	Ditto Pref. 5% tax free	20/6		*5	*5	7 5 0A	24/3	20/–	25/9	20/6
4,594,418	1	Ward (Thos. W.) Ord.	66/6	+9d.	25‡	20	3 15 0	86/–	64/–	167/6	83/–
7,109,424	Stk. (£1)	Westinghouse Brake	40/6		11	10	5 8 9	59/9	37/9	60/7½	39/–
225,000	2/–	Wolverhampton Die-Casting ...	9/3	+3d.	35	30	7 11 4	13/10½	8/3	13/1½	8/8½
591,000	5/–	Wolverhampton Metal	24/6	—4½d.	32½	27½	6 12 10	39/6	23/9	34/3	21/6
156,930	2/6	Wright, Bindley & Gell	3/9		15	20‡	9 13 6	4/3	2/10½	4/3	2/6
124,140	1	Ditto Cum. Pref. 6%	13/3		6	6	8 17 9	15/3	13/3	14/3	12/10½
150,000	1/–	Zinc Alloy Rust Proof	4/10½	+6d.	40	30	8 4 1	5/6	4/–	3/10½	2/9

•Dividend paid free of Income Tax. †Incorporating Zinc Corpn. & Imperial Smelting. ••Shares of no Par Value. ‡ and 100% capitalized issue. •The figures given relate to the issue quoted in the third column. A Calculated on £7 8 9 gross. D and 50% capitalized issue. C paid out of Capital Profits. E and 50% capitalized issue in 7% 2nd Pref. Shares. R and 33⅓% capitalized issue in 8% Maximum Ordinary 5/– Stock Units. ♣ and 6¼% from Capital Profits B and 50% capitalized issue. G and 1½d. special distribution. F and special 5% tax free dividend. H As forecast. ¶And 3 for 7 capitalized issue. L and 33⅓% capitalized issue. M and 10% capitalized issue. N Interim since increased. J and 75% capitalized issue. S and 40% capitalized issue. O calculated at 13⅓%. Interim on smaller capital. P Calculated at 11⅓%. Q also 1/– special tax free dividend and proposed 50% capitalized issue. T Per £1 unit. W Before capital reorganization.



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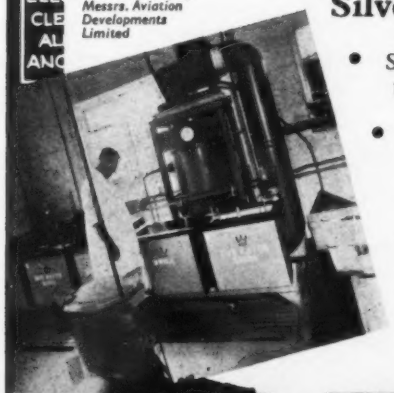

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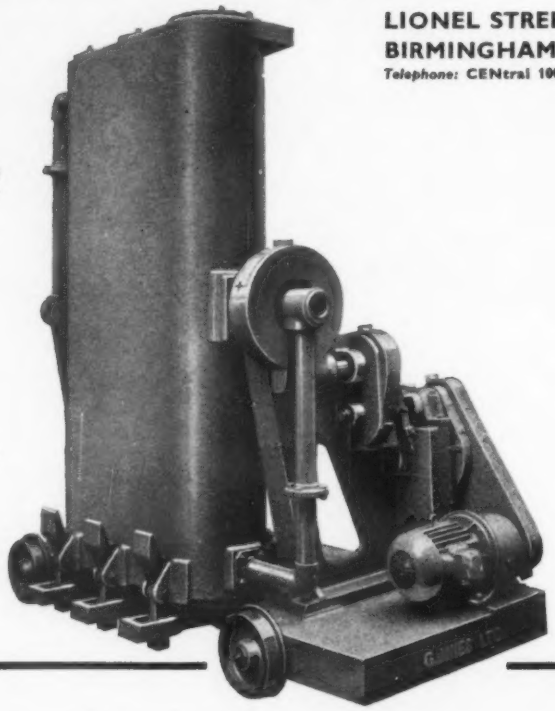

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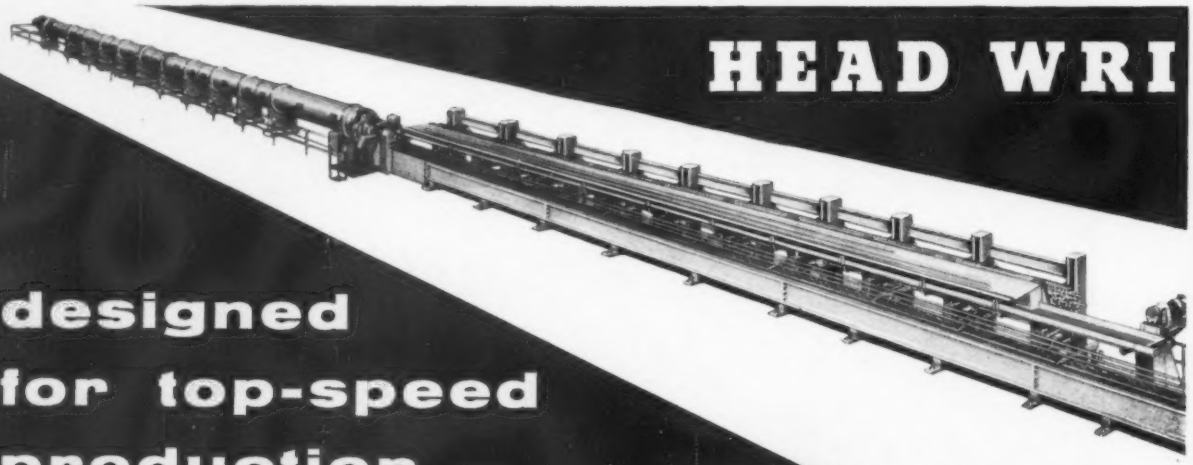

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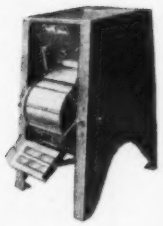

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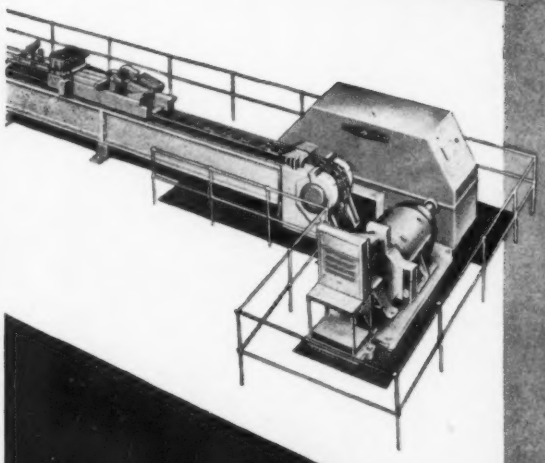

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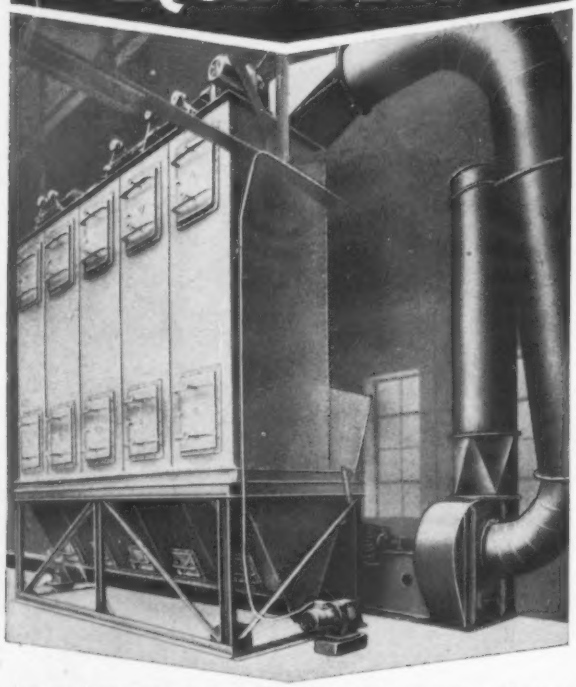

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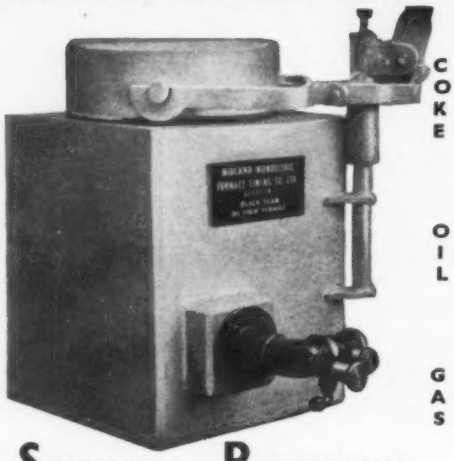

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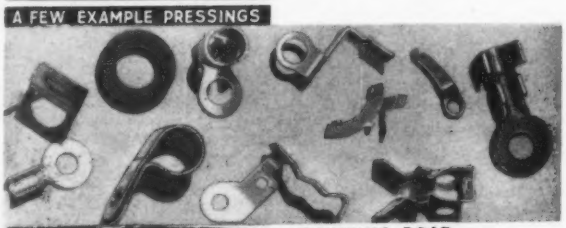

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